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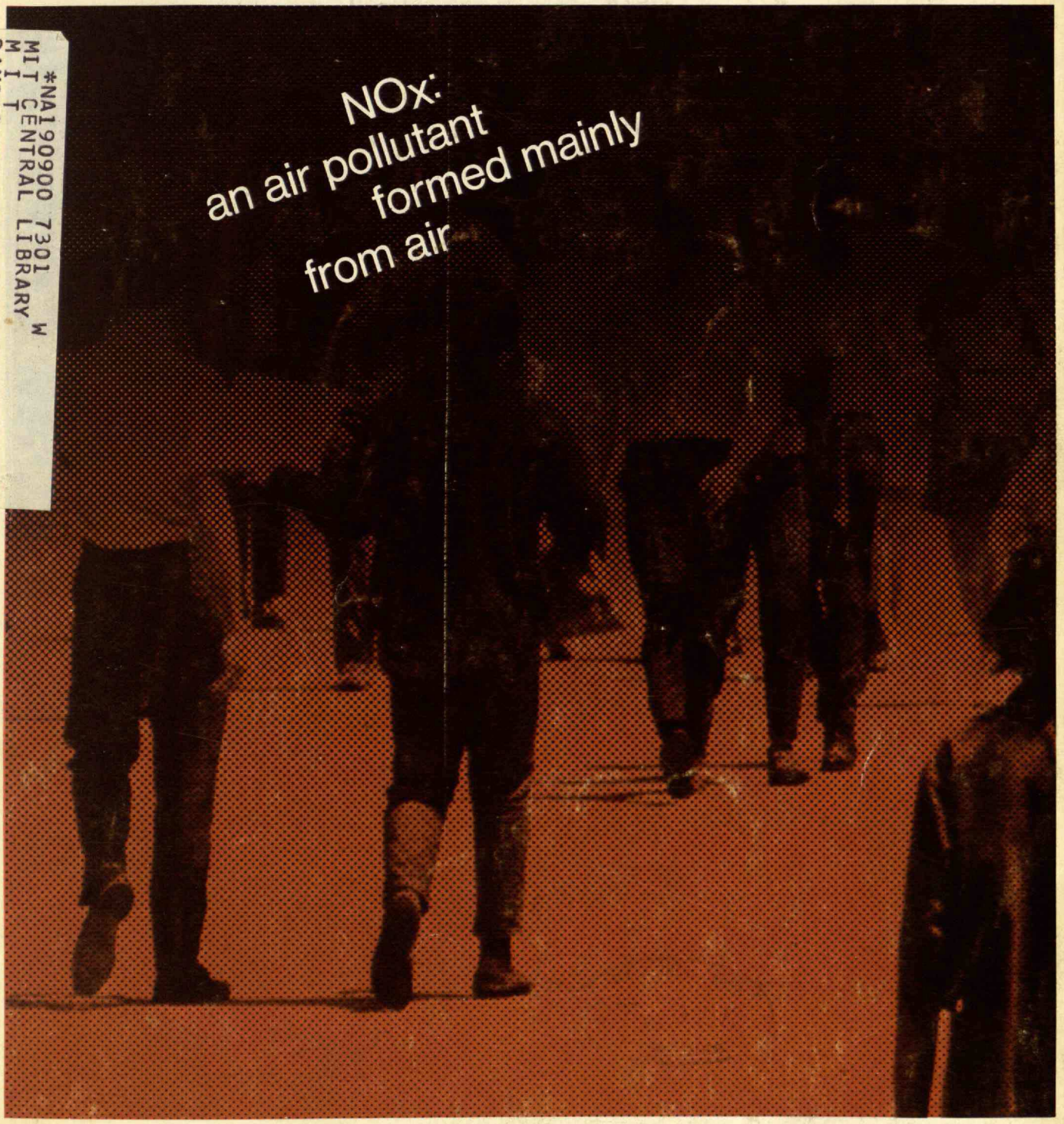
Michael D. Feirtag:
Engineering students' search for the ideal urban vehicle

Edited at the Massachusetts Institute of Technology

TechnologyReview



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This unique program of tours is offered only to alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Univ. of Pennsylvania, Columbia, Dartmouth and certain other distinguished universities and to members of their families. The tours are designed to take advantage of special reduced air fares which offer savings of hundreds of dollars on air travel. These are not for mass "charter" trips but special fares which apply to regular jet flights of the major scheduled airlines and which are usually available only to groups or in conjunction with a qualified tour. The savings are as much as $500 over the normal air fare, and special rates have also been obtained from hotels and sightseeing companies.

The tour program is consciously designed for persons who normally prefer to travel independently and covers areas where such persons will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine as much as possible of the freedom of individual travel with the convenience and savings of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest.

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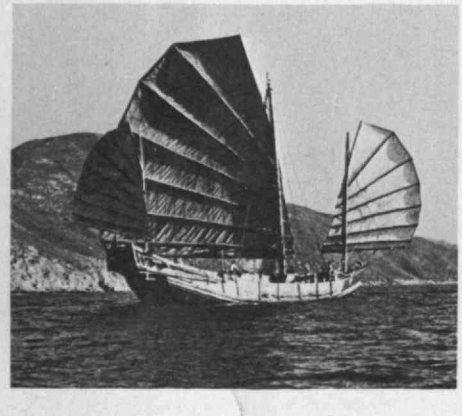

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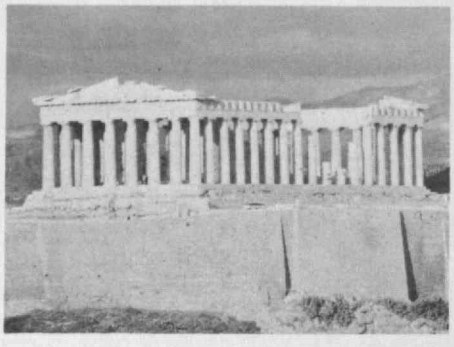
This outstanding tour, now in its ninth year of operation, offers the splendor and fascination of the Far East in comfort and at a realistic pace. The itinerary devotes eleven days to the beauty of JAPAN, visiting the modern capital of TOKYO, the lovely FUJI-HAKONE NATIONAL PARK, and places special emphasis on the great "classical" city of KYOTO, where the splendor of ancient Japan has been carefully preserved, together with excursions to NARA, the great medieval shrine at NIKKO, and the giant Daibutsu at KAMAKURA. Also included are BANGKOK, with its glittering temples and palaces; the cosmopolitan metropolis of SINGAPORE, known as the "cross-roads of the East"; the unforgettable beauty of HONG KONG, with its magnificent harbor and famous free-port shopping, and as a special highlight, the fabled island of BALI. Tour dates include outstanding seasonal attractions in Japan, such as the spring cherry blossoms, the beautiful autumn leaves, and some of the greatest annual festivals in the Far East. Total cost is $1899 from California, $2005 from Chicago, and $2074 from New York, with special rates from other cities. Departures in March, April, May, June, July, September, October and November 1973 ($27 additional for departures in July, September and October).



AEGEAN ADVENTURE

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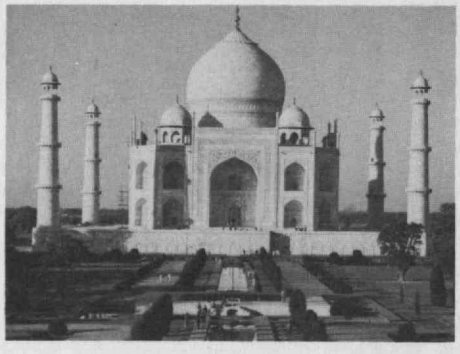
This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of ATHENS; the Byzantine and Ottoman splendor of ISTANBUL; the site of the oracle at DELPHI; the sanctuary and stadium at OLYMPIA, where the Olympic Games were first begun; the palace of Agamemnon at MYCENAE; the ruins of ancient TROY; the citadel of PERGAMUM; the marble city of EPHESUS; the ruins of SARDIS in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as CORINTH, EPIDAUROS, IZMIR (Smyrna) the BOSPORUS and DARDANELLES. The cruise through the beautiful waters of the Aegean will visit such famous islands as CRETE with the Palace of Knossos; RHODES, noted for its great Crusader castles; the windmills of picturesque MYKONOS; the sacred island of DELOS; and the charming islands of PATMOS and SANTORINI. Total cost is $1429 from New York. Departures in April, May, July, August, September and October, 1973.

SOUTH AMERICA

32 DAYS $1995

From the towering peaks of the Andes to the vast interior reaches of the Amazon jungle, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America: a brilliant collection of pre-Colombian gold and a vast underground cathedral carved out of a centuries-old salt mine in BOGOTA; magnificent 16th century churches and quaint Spanish colonial buildings in QUITO, with a drive past the snow-capped peaks of "Volcano Alley" to visit an Indian market; the great viceregal city of LIMA, founded by Pizarro, where one can still see Pizarro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, high in the Andes, with an excursion to the fabulous "lost city" of MACHU PICCHU; cosmopolitan BUENOS AIRES, with its wide streets and parks and its colorful waterfront district along the River Plate; the beautiful Argentine LAKE DISTRICT in the lower reaches of the Andes; the spectacular IGUASSU FALLS, on the mighty Parana River; the sun-drenched beaches, unforgettable mountains and magnificent harbor of RIO DE JANEIRO (considered by many the most beautiful city in the world); the ultra-modern new city of BRASILIA; and the fascination of the vast Amazon jungle, a thousand miles up river at MANAUS. Total cost is $1995 from Miami, $2080 from New York, with special rates from other cities. Optional pre and post tour visits to Panama and Venezuela are available at no additional air fare. Departures in January, February, April, May, July, September, October and November, 1973.



MOGHUL ADVENTURE

29 DAYS $1825

An unusual opportunity to view the outstanding attractions of India and the splendors of ancient Persia, together with the once-forbidden mountain kingdom of Nepal. Here is truly an exciting adventure: India's ancient monuments in DELHI; the fabled beauty of KASHMIR amid the snow-clad Himalayas; the holy city of BANARAS on the sacred River Ganges; the exotic temples of KHAJURAHO; renowned AGRA, with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous deserted city of Fatehpur Sikri; the walled "pink city" of JAIPUR, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of UDAIPUR; and a thrilling flight into the Himalayas to KATHMANDU, capital of NEPAL, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In PERSIA (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at PERSEPOLIS; the fabled Persian Renaissance city of ISFAHAN, with its palaces, gardens, bazaar and famous tiled mosques; and the modern capital of TEHERAN. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is $1825 from New York. Departures in January, February, August, September, October and November 1973.

Continued inside back cover

Our Small Gas-Turbine Engine...

100-160 HP Engine

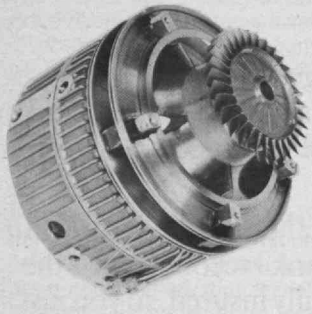
Initial tests show

—a capability of meeting the EPA emissions standards

—only one HP is required for starting

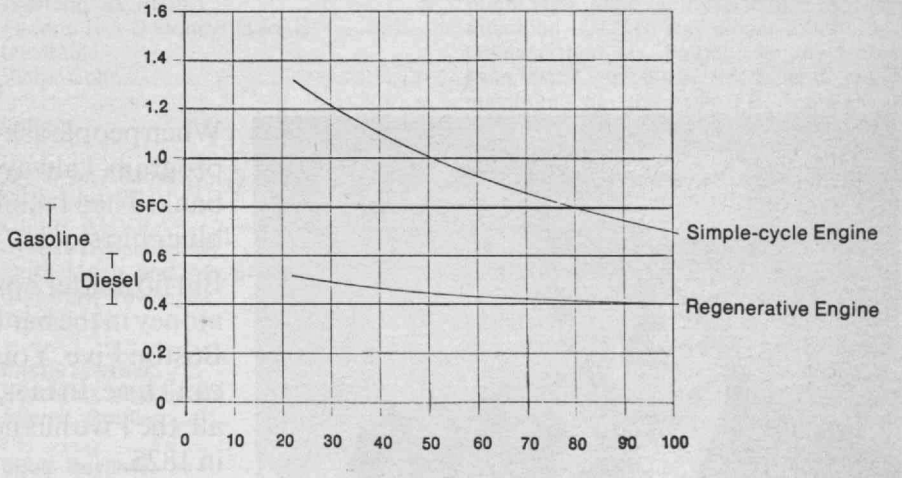
—a relatively low idle speed of 32,000 rpm

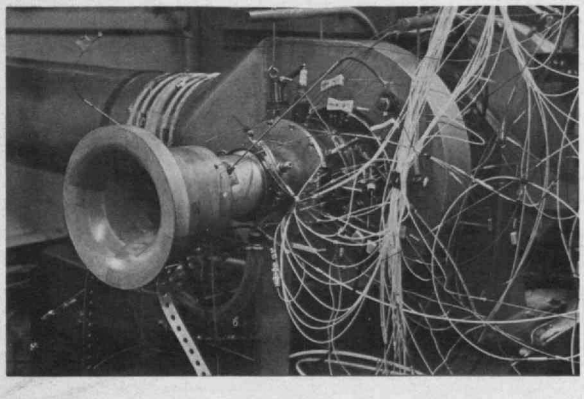
Initial production cost estimates vary between $3 and $5 per HP in quantities of 15,000 per year.



Power Turbine/Gearbox Assembly

Expected Performance





Prototype Engine on Test

Test-Rig Control Panel and Emissions Monitoring Equipment

Northern Research and Engineering CORPORATION

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Technology Review

Edited at the
Massachusetts Institute of Technology
Volume 75, Number 1
October/November, 1972

Articles

Departments

First Line

Volume 75
The opening of *Technology Review*'s 75th volume is not an occasion for spectacle—or even reminiscence. For it is not in fact the *Review*'s 75th year, the first issue having been published in January, 1899. Patience.

Michael Feirtag
This issue introduces Michael Feirtag to *Technology Review* readers through his colorful and thoughtful account of this summer's Urban Vehicle Design Competition (*see page 43*). No other reporter attending U.V.D.C. was closer to the contestants than Mr. Feirtag; he graduated from M.I.T. in June, 1972, and many members of the U.V.D.C. committee were friends and classmates. Mr. Feirtag joined the *Review* as Assistant Editor in August, having graduated in the multidisciplinary curriculum in physical sciences; in May he had won undergraduate prizes for writing and extracurricular activities.

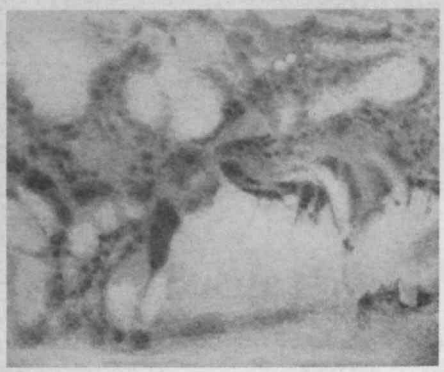
After participating in M.I.T.'s expedition to study the solar eclipse in eastern Canada (*see page 61*), O. Reid Ashe, formerly Assistant Editor, left *Technology Review* to travel in Central America and eventually to join the news staff of the *Charlotte Observer*. Readers who observe by-lines carefully will share our regret of his departure.—*J.I.M.*

The Growing Challenge

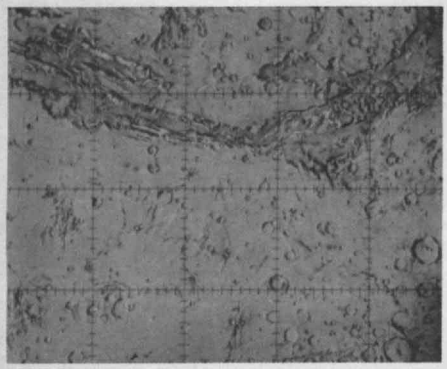
An Editorial

Nothing very original remains to be said—at least in the abstract—about the quickening pace of technological change. That notion has been in every engineer's lexicon at least since the end of World War II, and the truth of the matter became obvious to some with the invention of the Model T. Yet the practical impact of an abstract idea sometimes eludes us.

The illustrations on the next page are an



example: less than one year ago, our best map of Mars, the earth's nearest planetary neighbor, was that reproduced at the top of this page. This summer there was published by the U.S. Geological Survey the "Preliminary Mars Chart" reproduced (from *Sky and Telescope*) below. It is a "profound improvement" in our knowledge of the planet; indeed, "in a single step the resolution of global Martian charts has improved two orders of magnitude," writes the Mariner 9 Television-Experiment Team in the August issue of *Sky and Telescope*.



This particular example of rapid change through technology affects few terrestrial residents—and indeed, most Americans are completely unaware of it. But we are entering an era when rapid technological change will come to every house and driveway. Two examples suffice: In two years (unless we change our self-imposed requirements), the automobile, perhaps the most ubiquitous complex product of technology, must be very different—both safer and cleaner. And 30 years from now our resources and the energy they provide for transportation may be so changed that the interstate highway system, proclaimed but a decade ago and not yet finished, will be seen an artifact of a passed age. For by 2025—within the lives of many young people now entering college—world petroleum resources will be largely depleted, writes Earl Cook, Dean of the College of Geosciences at Texas A&M University, in an article to be published in the December issue of this journal; by then, he writes, we must have developed an efficient breeder reactor or be ready to enter a new era based on such renewable resources as wood and sunlight. Either alternative depends on "the use of technologies not yet known to be feasible, let alone economic," he writes.

Let those who think technology has reached the apex of its challenge, think again.—*J.I.M.*

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Accomplishments at Stockholm

Science Review:
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Would you believe:

☐ Margaret Mead is a tool of the C.I.A.?

☐ California's Hog Farm traveling "hippy" commune is an agent of American imperialism?

☐ *The Whole Earth Catalogue* is a facist document advocating the suppression of women?

If you can believe garbage like that, you can swallow the bigger charge of disgruntled leftists that last June's United Nations Conference on the Human Environment in Stockholm ended in failure because it didn't roundly condemn American "ecocide" in Vietnam. Official delegates could have had no more sincere accolade for producing an outstanding success.

These leftists were irked that Dr. Mead could turn their propaganda against them to keep protest discussions focused on environmental issues. They were peeved that the Hog Farmers' music and counterculture antics distracted attention from their own demonstrations. They were downright mad that delegates refused to let Vietnam or other divisive issues prevent the official sessions from reaching a number of significant agreements. So they called in the press on the last day and denounced the whole thing.

Several months later, these denunciations look pretty silly. You only have to consider Maurice Strong's own indices of success to sense the measure of the challenge the conference has asked the United Nations General Assembly to tackle this fall.

A Secretariat for Environmental Concerns

Before the conference met, Mr. Strong, speaking as its General Secretary, identified those indices as actions to set up machinery for on-going U.N. environmental coordination and a fund for its initial support. The conference has given the U.N. a plan for this machinery which would include a small secretariat, probably headed by Mr. Strong and guided by a governing council. It would report through the channels of the U.N.'s Economic and Social Council, yet have a large degree of autonomy. The conference also endorsed the American-suggested, five-year, $100-million initial fund to back the secretariat. Subscriptions and pledges are already coming in for the fund, including an American pledge—Congress willing—to contribute up to 40 per cent of the total.

Critics denounced this as a ludicrously inadequate response to the environmental challenge. They miss the point. To begin with, in asking for the new secretariat, the conference is urging the U.N. to embark on a new experiment in administration. While the new office couldn't directly order a U.N. agency, such as the International Atomic Energy Agency, to do something, it could strongly influence that agency through recommendations to the agency's governing board. Jealous of their domains, the specialized agencies are already fighting the concept. They foresee the energetic Mr. Strong goading them into environmental actions and cooperation they would never indulge in voluntarily. As John W. McDonald Jr., diplomatic advisor to the American delegation at Stockholm, observed, "The specialized agencies are extremely unhappy about what we're trying to do. They think we're trying to chip away at their fiefdoms. And that's exactly what we are trying to do."

Beyond its potential to galvanize U.N. action, Mr. Strong sees the proposed machinery as the key to a more effective global attack on environmental problems.

He rightly points out that these problems raise "one of the most pervasive, profound, and revolutionary issues man has ever faced." Causes of environmental decay are deeply rooted in mankind's established economic, military, and other cultural patterns. Correcting them will involve radical changes in many nations' life styles. There isn't a nation on this globe that today would tolerate the kind of direct international pressure needed to bring such changes. They can only come from within as all nations work together to manage the planet better.

This, Mr. Strong explains, is why the bulk of environmental action now must take place within nations or among small groups of nations. However, just as a telephone switchboard represents only a small part of the investment in a tele-

phone system, so the proposed U.N. coordinating machinery will be a small part of the global system of environmental management. Yet it is as vital to that system as is the switchboard to the telephone network.

Seen in this perspective, the five-year $100-million fund doesn't seem quite so much of a joke. The proposed secretariat couldn't usefully spend a multi-billion dollar budget were it given one. Not even the persuasive Mr. Strong could force governments to take the often politically unpalatable actions upon which the U.N. would have to insist to ensure wise use of large sums of environmental money. Most of the vast funds needed will have to come from the various governments' own sources, including aid arrangements, to be spent in programs they evolve themselves. The new U.N. machinery could help coordinate such programs into more effective global action and, with seed money, help encourage especially important projects.

A Few Specific Projects

Two examples widely discussed are the Earthwatch environmental monitoring system and the disaster warning system proposed by the conference. The former would be an enhanced world effort both to keep watch on the environment and to set more accurate data base lines against which to judge environmental trends. The latter would aim, with the help of satellites, to get warnings of major disasters, such as storm flooding, to individuals in the remotest areas. This would be a giant step beyond present warning systems that can alert regional centers but often fail to get the word to individual people. Either of these systems will call for new programs and equipment in many countries. Most of these will be funded within national budgets. But where a poor country can't afford this and where a facility there would be valuable for the program, the proposed U.N. environmental fund could help that country share in the effort.

These two proposed systems alone account for many dozens of specific suggestions for action agreed to during the conference. All told, the detailed agreements run to perhaps more than 200 items. They include a strong recommendation for a 10-year whaling moratorium that was sent to the International Whaling Commission. The I.W.C. rejected it but did set stricter quotas on fin whales and some other species. Although disappointed by the selfish I.W.C. reaction, conservationists were encouraged by the ability of the conference to override opposition on this sensitive issue. It shows whaling nations that, given an opportunity, world opinion will express itself strongly against whaling. This should keep up the pressure for an eventual moratorium.

Meanwhile, the strong suggestions delegates made to strengthen proposals for restrictions on ocean dumping may bear more fruit. With the Stockholm encouragement, such an agreement probably will be ready for signing later this year. It won't be perfect. It won't include river pollution, a "national" matter that constitutes one of the heaviest sources of ocean contamination. But, as William Ruckelshaus, administrator of the United States Environmental Protection Agency, pointed out, the world has a choice of getting at least limited protection of the seas, in terms that can be agreed upon now, or waiting an indefinitely long time for any protection at all.

And a Careful Will to Agree

These and other measures of agreement were worked out between June 5 and 16 in a context of potential political divisiveness that could have blown the whole conference into 114 national fragments. Years of preliminary discussions had already produced a level of environmental awareness around the world that heartened ecologists. They had ironed out many disagreements. Even so, the Soviet Union and many Eastern block countries refused to attend because East Germany could not yet be given official U.N. status. Although these countries were missed, the delegates got on with their work in the conviction that the Soviet block will soon join fully in world environmental efforts, probably in the U.N. discussions this fall.

The mismatch between rich and poor nations was and is far more serious. Rich countries see the issues in terms of cleaning up the physical environment. Poor nations see the pollution of poverty as the biggest ecological issue of all. It's a myth that they would "like to have the rich nations' environmental problems and economies." What they want are decent living standards achieved with minimum environmental damage. But they don't want rich nations' environmental standards imposed upon them to stifle their own economic growth. They insist that rich nations must help, and help heavily, to achieve this. And they want assurances that tighter environmental standards won't penalize their access to rich-nation markets.

Many a fiery speech was made on this issue. Many a deaf ear was turned to it. As Mr. Ruckelshaus observed, rich and poor "have been like two ships passing in the night. But at least this conference has made the night a little brighter." Nevertheless, while this remains the single most explosive issue on the world environmental scene, the Stockholm delegates did not let it, or any other discord, prevent the writing of a wide-ranging package of recommendations that now challenges the U.N. and the world to a new level of environmental action.

Margaret Mead aptly summed up that challenge during a press conference at the semi-official Environmental Forum. She was active in this and other sideshows where critics promised to show up the shortcomings of the official sessions. They succeeded only in aimless bickering and sterile echoing of warnings long since made. When one man, for the umpteenth time, condemned international corporations as the worst enemies of the environment, Dr. Mead looked at him sternly and said:

"We're just thinking of another bogey instead of thinking about what we can do about the environment. One of the important things is to stop fighting other people's ethics with which we disagree and

find ways in which we can work together. There's nobody here but us in this whole solar system, and we're responsible for life on this planet."

Federal R&D Money: More Is Inevitable

Washington Report:
Victor Cohn
Science Writer
Washington Post

The question, in this reporter's opinion, is no longer: will the government orchestrate American technology?

The question is: how soon?

At noon of August 17, 1972—six months after President Nixon's fiscal 1973 budget message, with the beginnings of his much vaunted "new technology" program—Senator Edward M. Kennedy rose on the floor of the Senate and proposed a "National Science Policy Act" that would go light-years beyond it.

Five hours later the Senate overwhelmingly agreed. The vote, despite White House displeasure, was 70 to 8, and this was evidence of two things. One was the skill of Senator Kennedy and his staff in putting together a bill that was almost irresistible to fellow senators.

The other is the fact that U.S. technology is still in serious trouble, and the Administration's response has not been enough to reassure legislators who are eager to associate themselves with some major remedy.

The Nixon promise, many feel, has boiled down to only three good-sized programs. One is the crusade against cancer (which Senator Kennedy stuffed down the Administration's throat). This crusade is undeniably popular but offers few jobs for unemployed defense or aerospace engineers. Another is the nuclear breeder reactor, which, right or wrong, has aroused no cheers from the environmentally minded. The third is the prospective space shuttle. Right or wrong way to go, it increases the enmity of many who say, "Do something for us on earth."

Has Edward Kennedy, then, rather than Richard Nixon, become the apostle of putting technology to work on the problems of society, in a year in which Nixon became the first president to offer the idea?

Deficits in Trade and Knowhow

Let us look back over 12 unique months in the politics of technology.

They started with official admission of some unhappy facts:

☐ The slippage of support for basic science and scientific training had gone far enough to begin to alarm even some of "Big Science's" severest critics. In constant dollars, Senator Kennedy pointed out, total federal research and development are down 16 per cent from 1967. In 1963 federal research and development money ran 2.6 per cent of the G.N.P. By 1971 it ran a mere 1.6 per cent.

☐ Western Europe, with a third the G.N.P., employed a third more scientists and technical personnel in civilian research. Japan, with half the U.S. population and one-seventh the G.N.P., had 70 per cent more in its civilian effort—a fact that helps answer those who say Japan "just copies" Western development.

☐ The U.S. was suffering its worst trade deficit, and, most alarming, had slipped in the high technology areas like electronics, computers and cars. Clearly, the Xerox machine and the magnetic memories of I.B.M. were not going to keep U.S. workers busy unless they were succeeded by an ever-fresh array of newer ideas.

Edward David, the President's science adviser—and a product of Bell Laboratories, the home of the transistor—had taken office with the hint that new adventures in the exploitation of technology lay ahead. He urged them on White House colleagues. Before long he was joined and even outflanked.

George Shultz, now director of the Office of Manpower and Budget; Peter G. Peterson, then director of the White House Council on International Economic Policy, now secretary of commerce; Maurice Stans, then commerce secretary, highly influenced by a pro-technology commerce economist, Michael Boretsky; Caspar (Cap) Weinberger—they convinced White House domestic chief John Ehrlichman and the President that the U.S. was under-investing in technology and something had to be done about it.

". . . Magruder Helped"

The White House's man to probe "new technological initiatives" was the ex-aerospace engineer William M. Magruder, who had headed the unsuccessful yet feisty campaign to build the S.S.T. Various task forces, including David's Office of Science and Technology, temporarily reported to Mr. Magruder as coordinator.

Mr. Magruder produced a "wish list" of nearly $1.5 billion worth of possible fiscal 1973 starts, including such sexy and truly needed efforts as a high-speed rail system for the Northeast; new deep-water ports; solid-waste disposal; and a wide range of electronic and computer systems, including a prototype "wired city."

The same White House group that ran Mr. Magruder up the flagpole more or less shot him down. Dr. David and a few staffers ticked off a list of the more saleable and economical ideas. The O.M.B. made a final revision, and Mr. Ehrlichman finally announced the results to Administration insiders, at what the *National Journal* in a delicious recounting labeled "an elaborate funeral and burial ceremony."

There was profound disappointment among those who had heard Mr. Magruder and others talk of a possible "billion dollar program." The President's proposed fiscal 1973 budget, unveiled in January, indeed contained a $700 million increase in civilian, non-space research and development—an impressive sum—yet there had been sizeable $500 million increases in 1965-66 and 1967-68.

High O.M.B. officials have credited the Magruder exercise with $400 million of the '72-'73 jump, though some lower-downs have said that the "real" increase, the money that would not otherwise have been in the budget, was more like $125 million. The fact, in any case, is that there *is* such an increase, and Bill Magruder and others should get their share of the credit. As one old White House hand said, "You have to go to the mat every year, and this time Magruder helped."

The New Congressional Bill

As another result, the President—both In his January State of the Union message and in a Presidential first, the March 16 science and technology message—pledged to use the federal strength "to marshal science and technology" to improve the American economy and quality of life. Whether or not the promise was accompanied by enough money to give it meaning, a new course had been stated. And the Great Projects at least remained in the file.

"I think we'll see some of these things done maybe two years from now," one White House official said recently. "By the way, the Democrats understand that."

No Democrat understands it better than Senator Kennedy, whose state possesses its share of hungry engineers and hungry job shops.

On August 17, then, he brought to the floor his bill to create a Civilian Science Systems Administration under the National Science Foundation. "Civ.S.S.A.," frankly modeled after N.A.S.A., would design and demonstrate "civil science systems" in "priority" areas like housing, transport, pollution control, energy production, public safety, health, education and communications. It would help retool individuals and companies.

Its proposed price tag was $1.8 billion for three years. The idea is "unneeded and wasteful," said that able conservative workhorse, Senator Peter Dominick (R-Colo.), as debate began. Senator Hubert H. Humphrey (D-Minn.), replied, "We ought to have had this legislation four years ago. It's been desperately needed," and he told of interviewing an unemployed engineer who was selling fish bait to avoid going on welfare. Senator John Tunney (D-Calif.) said 400,000 aerospace workers had been laid off in California alone, and it was "absolutely inexcusable" that the Administration had made no major plan to take up the slack left by aerospace and defense cuts.

Senator Dominick proposed two limiting amendments. Each was defeated. Then he proposed a third change: cut the $1.8 billion to an even billion. All right, answered Senator Kennedy—he and Senator Dominick and their aides had been out in the corridors talking. And the entire measure now passed, after nearly five hours' debate, by that fantastic margin of 62 votes, including Peter Dominick's.

There may or may not be enough time to get a House vote this busy election year. If there is no House vote this year, the Senate will have to act again, but this is usually easier after so massive a commitment. It is hard to predict anything at this moment in Washington—I write well before the November election, whose result could change the House's and Senate's composition—but there was wide

agreement on the Senate floor on August 17 with one of Senator Dominick's final statements: "We've got to persuade the scientific community to devote more time to these problems that we all consider important."

There is nothing so persuasive as federal money, and the federal commitment to begin spending it could just conceivably come in late 1972. If not then, it could come in 1973 or 1974 under a President McGovern or President Nixon, spurred by the 1972 Nixon commitment, and, if the House agrees with the Senate, by the new bi-partisan Congressional will.

Letters

Learning From History

I am delighted to see in the May issue the two excellent articles on V.T.O.L. development by Henry B. Faulkner and Charles W. Harper and Hans Mark. This letter adds some supplementary comments and suggests still another historically successful approach toward creating this new aircraft type and the sorely needed short-haul improvement it will achieve. We have some reservations regarding the attainment of V.T.O.L. through S.T.O.L.

V.T.O.L. and S.T.O.L. design parameters and operational environment are quite divergent. The best S.T.O.L. is the slowest-landing S.T.O.L. This requires enormous wings and tail surfaces even when some powered lift is added, and that will be a definite requirement for transports operating from 1,500-foot runways. How much power? The more the better! Then interconnect is needed between the lifting discs or blown wing and tail segments. Soon all the complications of V.T.O.L. are added to the complexities of wing ducts and high-lift devices. The optimum design escalates to the ultimate of 100-per-cent-powered lift. Then we start to simplify. Simple unflapped wings are designed only for the cruise mode and become very small and light. Landing gear weight is greatly reduced. Controls are more positive right down to zero speed. The size, weight, and quite possibly the cost are greatly reduced. Why go "through" S.T.O.L.?

Airports, vertiports, and ground transportation are all a part of systems costs whether paid for by customers or municipalities. Neither article explored these costs in depth. V.T.O.L. systems costs bid well to be the lowest of all. Messers. Harper and Mark propose that direct operating costs of two cents per seat-mile would be needed to be competitive, but would not any traveler be willing to pay more for the flight segment of his trip in exchange for reducing the ground cost and time? One-day business trips may originate in the suburbs, but nearly all of them terminate in the heart

of a big city.

Mr. Faulkner seeks a development program based on carefully researched designs, systems and operations. Mr. Harper seeks to carefully plan an "analytical approach" but rightfully adds, "We must not by-pass evolutionary steps based on some prior closely related very successful operations."

I agree with both. However, I despair of either method producing the ultimate V.T.O.L. system full-grown, fully operative, in one grand effort. History shows the way. We developed airplanes starting with very small ones. We developed helicopters and transport airplane systems the same way, by starting small first. The growing development brought design technology, airports, maintenance, navigation facilities, air traffic control, weather reliability, safety, and all the associated support requirements along simultaneously in practical co-ordination. The early transports carrying small payloads lost money and needed government subsidies just as did river steamers, the merchant marine, railroads, and super-highways. I believe viable V.T.O.L. systems would come more practically, faster, and for less expense if the government subsidized small operating V.T.O.L.'s first. Sure—they would start with no more weather reliability than early transport airplanes; at first services would be specialized and crude. But the ultimate short-haul facilities would mature faster on a firmer basis, for less cost.

Franklin T. "Hank" Kurt
South Brooksville, Maine

Putting It Loosely

Robert Cowen and the "solar energy prophets" are quite right in pushing for more support for solar energy research and development (*"Science Review," February pp. 5-7).*

I do wish they would stop harming their cause by the loose use of terms like "efficiency" and "waste heat". Solar energy looses no waste heat into the environment in the sense that fossil or nuclear fuels do. In fact, it removes some heat from the collection locale and looses it in the users' locale; at the collection site this is, if anything, a negative value of waste heat. From the point of view of the biosphere, earth-surface collection and use of solar energy is the only technique free of waste heat.

In these global discussions of our energy problem, people frequently think of efficiency in terms of low environmental pollution plus, perhaps, parsimonious use of limited fuels. In this sense solar energy might be thought of as one-hundred per cent "efficient" even though collection and conversion percentages may be low.

The public and our regulatory agencies are easily confused on issues like this. Witness the complete lack of concern over the indiscriminate use of electric heating for homes, offices, and factories. No one seems to care that about two-thirds of the fuel value of our coal, oil, or gas is lost in combustion and conversion for electric home heating as compared to only about one-fifth lost in direct use! Our scarce natural gas should be conserved for home and office heating since it burns so cleanly in simple small furnaces; and electric power rates should reflect more the inefficiencies involved and less the economics of summer-winter load balancing.

William N. Papian
Saint Louis, Mo.

Why Waste Nuclear Wastes?

You had a good article about the disposal of nuclear wastes (*see* Technology Review *for March/April, 1972, pp. 15-19*). The question is what makes these particular materials wastes rather than usable byproducts? An object whose temperature is 930°C. (p. 18) seems to me to be a good heat source. What prevents the reuse of these materials?

David C. Lukens
Suakoko, Liberia

The following answer is proposed by Professor Arden L. Bement of M.I.T.'s Department of Metallurgy and Materials Science:

The inquiry by David C. Lukens is a very appropriate one. At the present time Cs^{137} and Sr^{90} are extracted from fission product wastes for use in power sources for which a market exists. Although most fuel reprocessing plants have installed byproduct extraction facilities for removing noble metals, technetium, xenon, and other isotopes from fission products, these facilities are presently idle because of the lack of an adequate market for these byproducts.

Several heat engines, batteries, and thermoelectric devices based on fission product heat sources have been studied over the past ten years; however, there is not yet sufficient incentive or benefit relative to cost to carry these studies into development. Nevertheless, the magnitude of the fission product thermal inventory by the year 2000 warrants continuing attention to the potential use of fission products for energy conversion applications.—*A.L.B.*

The Successful Parasite

Referring to Mr. Joffe's letter in the March/April *Technology Review (p. 4),* we can look a little more closely at parasitism. Speaking generally, a successful parasite and a successful host show some sort of coadaptation, or we might say, have arranged an armed truce. If the host is too successful at eliminating the parasite before the latter can reproduce or, on the other hand, the parasite is too successful in preventing reproduction in the host, the parasite is doomed.

The successful parasites do one of two things. They reproduce and leave the host alive long enough for the latter to reproduce, or, if they kill the infested host before it can reproduce, then the parasites infest only a fraction of the possible host individuals.

Charles H. Blake
Hillsborough, N.C.

Unanswered Question?

It seems to me that your editorial in the June *Technology Review* (*p. 3*) questioning education in general fell short of being valuable because it only asked questions and proffered no answers. When you write, "Are we really working on the questions that count?" and "Are we working on useful products?" what is your guidance?

To me the increasing materialistic life with its idle cars, radios, television sets, and stereos, has to be gradually changed into a less resource-wasting, world-polluting way of life, with less produced and less consumed. This move will be traumatic to Madison Avenue ("Buy less!") but I am sure they will rise to the emergency.

Less produced and less consumed means less employment. I see no other answer to the unemployment problem than a shorter work week and a shorter work life with a larger percentage of income laid away during that life to provide an earlier retirement. This in turn greatly expands "idle" time.

Currently, a man working from age 20 to 65, 200 days a year, and living to age 70, works about 25 per cent of his waking hours. Most are hard pressed to fill the other 75 per cent without a lot of beer and television. As I see it, as we move towards working perhaps 15 per cent of our waking hours, the need for education to enjoy our leisure will become ever more important. (It is perhaps whimsical that future generations will work hard in college to learn a skill used only 15 per cent of their time.) Thus it is time that our educators consider educating for both working and idle time.

As is usual with change, it is here before we notice it. At the corporation where I work (7000 employees), 30 per cent of the people are taking some sort of study course *every* day.

Alan Pope
Albuquerque, N. Mex.

Recycling Update

The article by Messers Wilson and Smith in the May issue, caught my particular attention. In their discussion of various "binary" separation methods, one that seemed missing occurred to me; they may have already considered it and dismissed it for good reasons. In any event, it seems worth mentioning.

In a very early stage of separation, if the conglomerate were passed over an aperture with a suitably strong, upwardly directed, continuous air stream, the dense materials, such as metal objects, ceramics, etc., would drop out while the less dense materials would pass along for further processing. Large items like engine blocks and bed springs might have to be removed earlier, relying on visual or other suitable recognition.

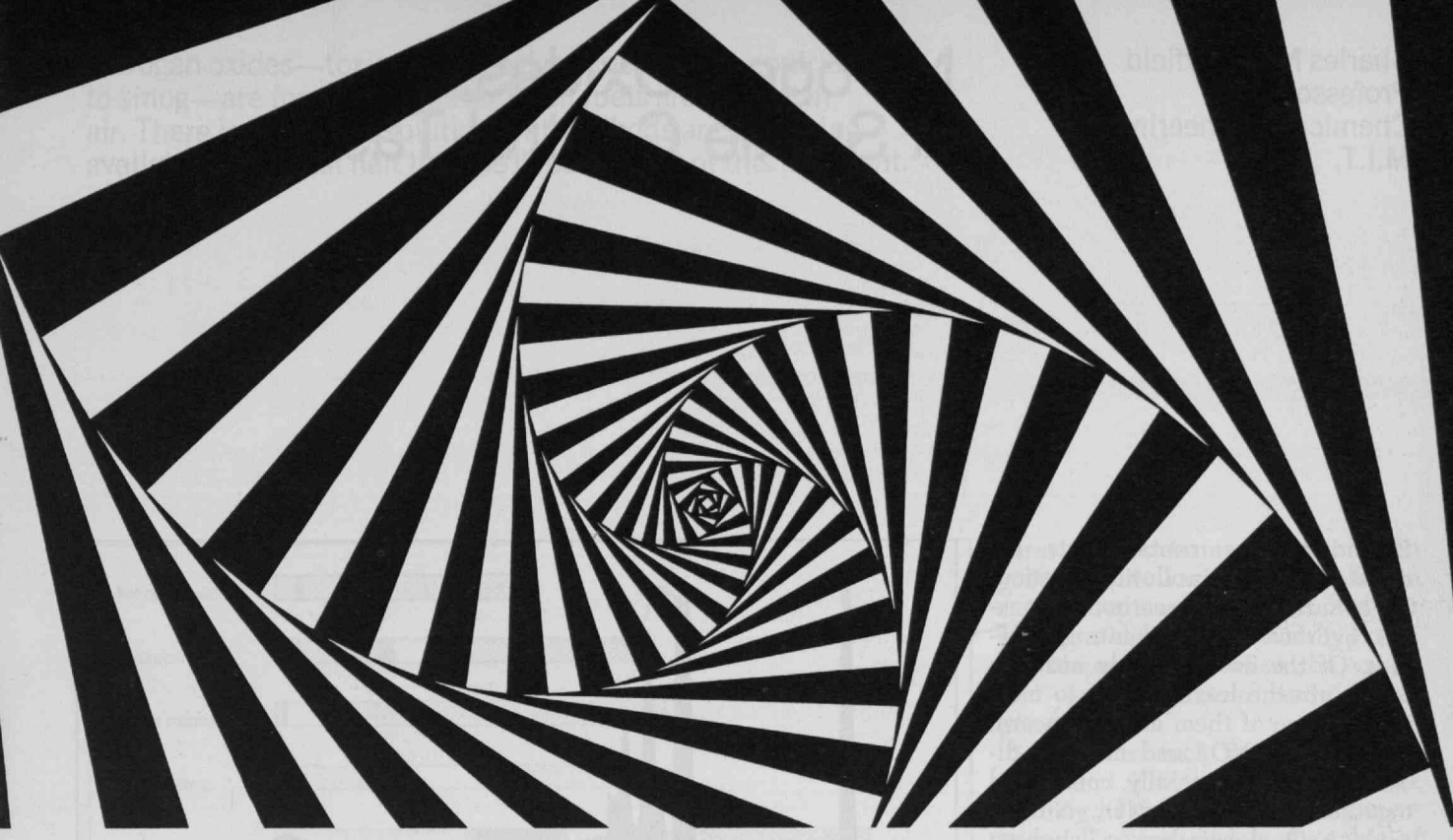
True, the authors cover several air switch schemes based on rather sophisticated recognition and the S.R.I. method that requires prior pulverizing. What I have in mind would be quite unsophisticated but might make the later stages easier to implement.

M. B. McDavitt
Red Bank, N.J.

Dr. Wilson replies:

Mr. McDavitt is absolutely right. We have switched most of our efforts now to this problem of presorting; since the

(Continued on page 72)



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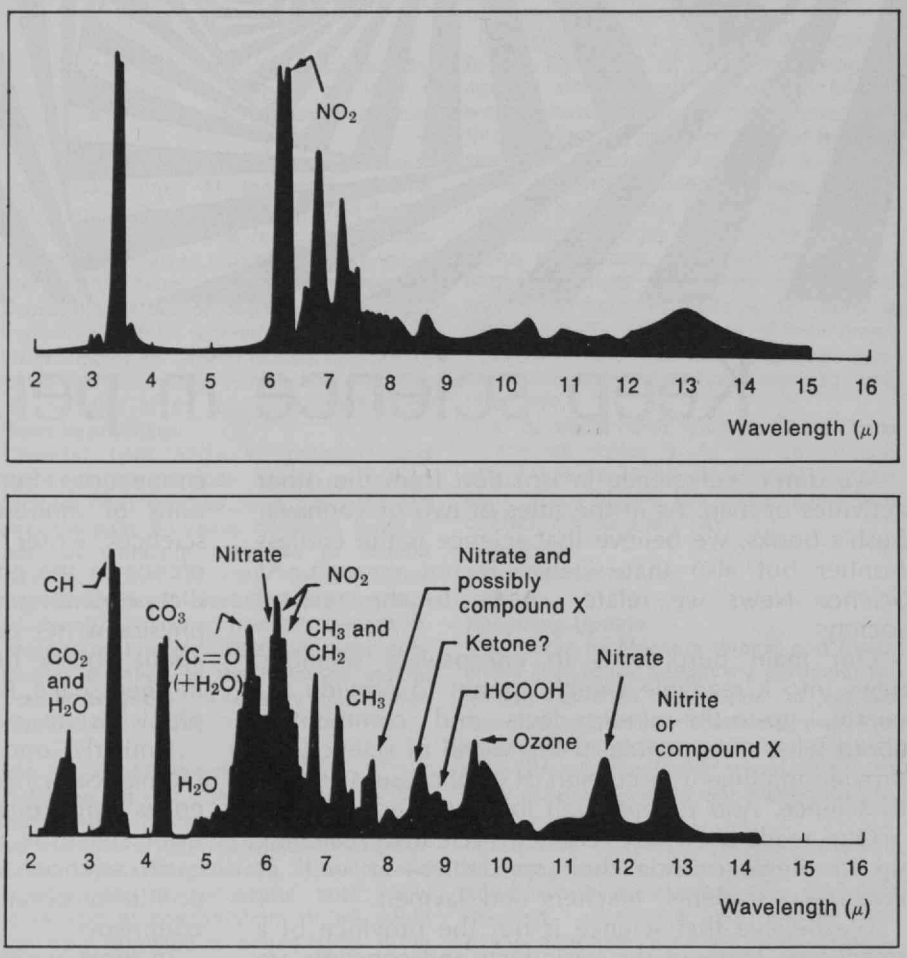
Charles N. Satterfield
Professor of
Chemical Engineering,
M.I.T.

Nitrogen Oxides: A Subtle Control Task

Essentially five contaminants account for most air pollution: particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Of the five, probably nitrogen oxides are the least familiar to most people: two of them are of concern, nitric oxide (NO) and nitrogen dioxide (NO_2)—generally considered together and termed NO_x. Nitrous oxide, N_2O, also known as "laughing gas," is emitted by some chemical processes and is produced by natural biological processes, but is believed to be innocuous and it is not included in the definition of NO_x.

Both NO and NO_2 can have direct adverse health effects, NO_2 being considerably the more toxic of the two at equal concentrations. The reddish color of NO_2 can also contribute to haze and decrease visibility (NO is colorless). Moreover, NO and NO_2 interact with hydrocarbons in the atmosphere under the influence of the ultraviolet energy of sunlight—in a highly complex and only partially understood series of reactions—to generate eye irritants: these include ozone (O_3) and the substances known as PAN (peroxyacetyl nitrate and related compounds) and PBZN (peroxybenzyl nitrate and related compounds). The role of NO_x in photochemical smog reactions began to be elucidated in Los Angeles in the early 1950s, but only fairly recently has it become generally recognized that contamination of the air by NO_x can be a general urban problem and not one somehow peculiar to the Los Angeles area.

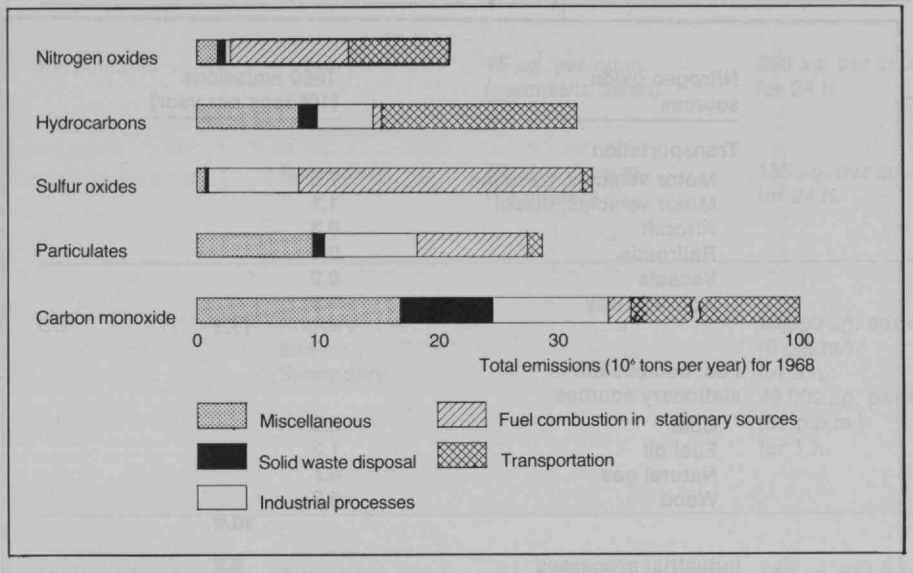


Nitrogen oxides, in sunlight, can react with other compounds present in urban air to produce the very complex mixture known as photochemical smog. The process was first reproduced in the laboratory by Professor Arie Jan Haagen-Smit, of the California Institute of Technology, who tells the story of the discovery in the June 1972 issue of *Chemtech* (pp. 330-335), from which this illustration is adapted. The effect of irradiating a dilute mixture of NO_2 and a hydrocarbon (3-methyl heptane) in oxygen is shown in the form of an infrared spectrum, which reveals the multitude of molecules and groups that are formed—still not all identified—some of which then take part in further reactions.

The nation's program for control of air pollution is specified in two federal laws, the Air Quality Act of 1967 (Public Law 90-148, as amended) and the Clean Air Amendments of 1970 (Public Law 91-604). These acts provide a mechanism for developing emission stan-

Charles N. Satterfield, Professor of Chemical Engineering at M.I.T., came to the Institute in 1942 with a B.S. degree in chemistry from Harvard and joined the faculty in 1946. His research and teaching interests center in heterogeneous catalysis and chemical reactor engineering. This article is drawn in part from the recent report of the *ad hoc* Panel of the National Academy of Engineering on Abatement of Nitrogen Oxides Emissions from Stationary Sources, of which he was Chairman.

Nitrogen oxides—toxic in themselves and a major contributor to smog—are formed whenever fossil fuels are burned in air. There is no simple solution, but methods are becoming available to at least halt the rise in our output of this pollutant.



The estimated nationwide emissions of the five major classes of air pollutants, in millions of tons per year, as of 1968. Although carbon monoxide far exceeds other pollutants by weight, the oxides of nitrogen and sulfur become of concern at lower concentrations than does CO. The tonnages of SO_x and NO_x given are those that the sulfur and nitrogen oxides would reach if they were to be entirely converted from their actual mixed forms to the dioxides, SO_2 and NO_2.

dards for existing sources (to be enforced by the states) and performance standards for new sources, to be enforced by the Environmental Protection Agency (E.P.A.). For automobiles, emission standards are set by the federal government except for the state of California, which for automobile model years 1973 and 1974 is permitted to specify standards which are slightly more stringent than those for the U.S. as a whole.

The dimensions of the overall air pollution problem, and the role of nitrogen oxides in particular, are succinctly outlined by the accompanying bar-chart and tables. The first gives the estimated nationwide emissions of the five principal air pollutants, the first table summarizes the estimated nitrogen oxide emissions of the known man-made sources in the United States, and the second lists the national ambient air quality standards.

The Standards

The *primary* ambient air quality standards are those judged to be needed to protect public health; the secondary standards are those judged to be needed to protect the public welfare—they represent levels above which damage to vegetation, buildings, etc., may become significant. (For NO_x the secondary standard is the same as the primary.) The standards specify an annual mean value and a maximum value not to be exceeded more than once a year. The table also lists so-called "danger point levels" issued by the E.P.A. as a guide to the states. These represent concentrations which could cause significant harm in short-term emergencies. In general, the various air pollution control regions have specified air pollution alert levels which typically fall somewhere between the values for "yearly maximum" and "danger point."

Substances such as NO_2, ozone, PAN, and PBZN, which contribute to smog in the manner already mentioned, are included in the table of air quality standards under the general head "photochemical oxidants." Analytically, this group is measured as a single type of substance.

A comparison of the illustrations on pages 11 and 13 shows that although carbon monoxide is the most serious air pollutant by volume or weight, other pollutants become of serious concern at much lower concentrations than does CO. In both quantity and degree of health hazard nitrogen oxides appear to be nearly comparable to sulfur oxides in their contribution to air pollution.

Nationwide emissions, however, give only a part of the story. Worldwide, natural sources of NO_x produce on the order of ten times the amount emitted from man-made sources. The problem is that the man-made sources—primarily, fuel combustion in furnaces and in engines—are located predominantly in urban areas, so that urban concentrations are generally between 10 and 100 times higher than non-urban, the latter being usually less than 10 micrograms per cubic meter. The first table shows that about half of the total man-made NO_x emissions are from stationary sources, primarily the fossil-fuel-fired boilers of electric utilities and industrial furnaces. The automobile is the other major source. NO_x has a residence time in the atmosphere of about three to four days (it is prob-

ably converted to nitric acid, and precipitated or washed out of the atmosphere in that form or as nitrates, so that NO_x is a regional rather than a global contaminant; it does not exist in the atmosphere long enough, normally, to travel more than a few hundred miles. The central problem is not, therefore, how much NO_x is released to the atmosphere as a whole, but where. If cities could be reliably and continuously ventilated, the problem would be much less. But we must make do with the winds and calms that nature provides.

It is estimated that, at the 1970 level of control, NO_x emissions would approximately double by the year 2000. The need to reverse this trend is evident. What counts is the NO_x at ground-level, to which the mobile sources presumably contribute a greater share relative to the stack emissions than the first two tables would indicate. However, the relative ground level contributions from stationary and mobile sources are also affected by stack height and meteorological factors; these effects will vary substantially from city to city. There are still a number of sources for which the amounts of NO_x emitted, and the resulting concentrations, are not well established —for example, engines used to pump gas in pipelines, and commercial and domestic sources such as incinerators, space heaters, water heaters, ranges, and various small engines such as those in motorcycles and motorboats.

The E.P.A.'s recommendations to the states include suggested standards for NO_x emissions from existing fuel-burning equipment and nitric acid plants. The Agency has also promulgated standards of performance for new stationary sources.

Nitrogen oxide sources	1969 emissions (10^6 tons per year)	
Transportation		
Motor vehicles, gasoline	7.6	
Motor vehicles, diesel	1.1	
Aircraft	0.3	
Railroads	0.1	
Vessels	0.2	
Non-highway	1.8	
		11.1
Fuel combustion in stationary sources		
Coal	3.8	
Fuel oil	1.3	
Natural gas	4.7	
Wood	0.2	
		10.0
Industrial processes		**0.2**
Solid waste		**0.4**
Miscellaneous		
Forest fires	1.6	
Coal refuse	0.1	
Agricultural	0.3	
		2.0
Total		**23.7**

A more detailed look at the sources of nitrogen oxides indicated in the previous figure (again in millions of tons: figures are for 1969, from the Environmental Protection Agency) shows that the predominant sources are automobiles and large furnaces. Federal law requires roughly a ten-fold reduction by 1976 of NO_x emissions from automobiles, which will probably require special catalyst units still under development; as to furnaces, combustion can be controlled to reduce NO emissions in the case of gas and oil furnaces, but much more research will be needed to do the same for coal.

(The two sets of standards are summarized in the table on page 15.)

The Clean Air Act of 1970 establishes mid-1975 as a target date for bringing local pollution levels below the primary standards. Each state was expected to submit a plan to this end by the summer of 1972, but the E.P.A. is empowered to impose its own rules if it deems the states' plans inadequate. A number of states with heavily populated areas have been given an extra two years —until mid-1977—to comply, in large part because of recognized uncertainties as to proper strategies for reducing air pollution from transportation.

With respect to nitrogen oxides, the air in many U.S. regions may actually be cleaner than was previously believed: the E.P.A. revealed this June that a technical error exists in the collection efficiency

Pollutant	Type of standard	Annual mean	Maximum: not to be exceeded more than once a year (h. = hours)	"Danger point": significant harm to human health (h. = hours)
SO_2	Primary	80 μg. per cu.m. (.03 p.p.m.) (arithmetic mean)	365 μg. per cu.m. (.14 p.p.m.) for 24 h.;	2620 μg. per cu.m. (1 p.p.m.) for 24 h.
	Secondary	60 μg. per cu.m. (.02 p.p.m.)	260 μg. per cu.m. (.10 p.p.m.) for 24 h. 1300 μg. per cu.m. (.5 p.p.m.) for 3 h.	
Particulates	Primary	75 μg. per cu.m. (geometric mean)	260 μg. per cu.m. for 24 h.	1000 μg. per cu.m. (or "coefficient of haze" of 8) for 24 h.
	Secondary	60 μg. per cu.m. ("a guide")	150 μg. per cu.m. for 24 h.	
CO	Primary and Secondary		10,000 μg. per cu.m. (9 p.p.m.) for 8 h.; 40,000 μg. per cu.m. (35 p.p.m.) for 1 h.	50 p.p.m. for 8 h. 75 p.p.m. for 4 h. 125 p.p.m. for 1 h.
Hydrocarbons (not including CH_4)	Primary and Secondary		160 μg. per cu.m. (.24 p.p.m.) for 3 h., 6 a.m. to 9 a.m. ("a guide")	
Photochemical oxidants	Primary and Secondary		160 μg. per cu.m. (0.08 p.p.m.) for 1 h.	0.4 p.p.m. for 4 h. 0.6 p.p.m. for 2 h. 0.7 p.p.m. for 1 h.
NO_2	Primary and Secondary	100 μg. per cu.m. (.055 p.p.m.) (arithmetic mean)		3750 μg. per cu.m. (2 p.p.m.) for 1 h.; 0.5 p.p.m. for 24 h.

The national ambient air quality standards, published last year, specify ceilings for the annual mean concentrations and annual maxima. "Danger point" levels have also been published as a guide to the states in their development of regional control plans. The maxima and danger levels are defined as concentrations persisting for a given length of time. For some pollutants a distinction is made between primary standards—which are chosen for the protection of public health—and secondary standards, for protection of public welfare, such as preservation of buildings and vegetation. The concentrations are generally specified in terms of mass per unit volume of air; in this table, those for gases are also translated into parts per million. Nitrogen oxides appear in the standards in two forms: as one of the "photochemical oxidants" which tend to produce smog, and in the specific form of NO_2, which is more toxic than NO. In developing emission standards it is generally assumed that all of the NO_x emitted will be converted to NO_2, although the extent to which this actually occurs can vary greatly. ("Coefficient of haze" is an empirical measure of particulate concentration. A ceiling is also set on the product of particulate concentration and SO_2 concentration, since health hazards from one are made worse by the presence of the other.)

assumed in the standard (Jacobs-Hochheiser) analytical method used to determine NO_2 levels. (Collection efficiency is the fraction of the amount of NO_2 passing through the system that is actually detected and measured.) The efficiency figure used hitherto is valid at NO_2 concentrations in the region of 100 micrograms per cubic meter, and hence does not affect the primary standard, but it results in erroneously high values at lower NO_2 concentrations. The E.P.A. is now re-evaluating actual NO_2 levels in those regions where NO_x controls are believed to be required.

The need to press ahead with control measures for NO_x is evident, but it is also proper to recognize that the ambient air quality standards for NO_x rest on a relatively small base of data on physiological effects, particularly a series of studies on schoolchildren in Chattanooga, Tennessee. The need for more studies on the degree of health hazard is apparent.

Improving Combustion Processes

Almost all the NO_x emissions arise from combustion processes. The nitrogen oxides are formed primarily by chemical combination of oxygen and nitrogen from the air. Secondarily, liquid and solid fuels may contain small amounts of nitrogen compounds, which can also produce NO_x when burned. Although only a tiny fraction of the nitrogen in the air passing through a furnace, and likewise only a portion of the nitrogen compounds in fuel, is oxidized to NO_x, the total tonnage of NO_x emitted to the atmosphere in the U.S. is the equivalent of ten times the U.S. production of nitric acid.

The "fixation" of nitrogen and oxygen proceeds by a chain-reaction mechanism which is only partly understood, but the overall reaction can be represented by the following equation: $N_2 + O_2 \rightarrow 2NO$. The rate and extent of this reaction increase very rapidly with increased temperature. NO_2 can be formed by further oxidation of the NO; however, all but 5 to 10 per cent of the NO_x emitted from most combustion sources is NO. (Note that nitrogen oxide formation differs from sulfur oxide formation, in that the amount formed is determined essentially by the nature of the combustion process, whereas SO_x emissions are directly proportional to the sulfur content of the fuel.)

The concentrations of NO actually found in the stack gases from a furnace are in fact much less than the concentration that could exist in equilibrium at the flame temperature in the furnace, but much greater than corresponds to the temperature of the exiting gases. The stack concentration is determined by the history of the gases as they move through the furnace—the variations of temperature and composition with time.

Fundamental difficulties remain in understanding just how the NO is formed in a furnace. With uncontrolled combustion, the amount of NO_x formed per unit of heat released can vary by as much as a factor of 10, depending upon a number of interrelated considerations:

- ☐ the fuel (oil, coal, or gas);
- ☐ the percentage of excess air used;
- ☐ the size of the furnace;
- ☐ the burner design;
- ☐ the percentage of its rated capacity at which the furnace or boiler is being operated.

In practice, regimes are being discovered which reduce NO_x emissions from furnaces. Of the three fuels used (gas, oil and coal), gas allows the most precise control in the reduction of NO_x levels and the least is known about the control of coal firing. A realistic objective for a new plant using natural gas, to be placed in operation by 1980, is an emitted NO_x concentration of about 100 parts per million—a worthwhile reduction from present-day uncontrolled levels which average about 350 to 400 p.p.m. and may range as high as 1400 p.p.m. However, natural gas may not be available as a fuel for utility boilers very far into the future.

For oil, a realistic objective in plants placed in operation by 1980 is about 150 to 200 p.p.m., as compared with present-day levels ranging from 200 to 700 or more (depending upon the burner design). As to coal, little is known from direct experience about how to reduce NO_x emissions, and studies of coal combustion with this goal in mind are specially required.

Both theory and practice indicate several means of substantially reducing NO_x emissions. Reducing the amount of excess air is effective, because it cuts down the availability of oxygen. Introducing the air in stages, so that partially burned fuel and combustion products are permitted to cool before combustion is completed, avoids exposing the nitrogen simultaneously to oxygen and to high temperatures. Recirculation of flue gas into the combustion zone dilutes both the fuel and the air, lowers the flame temperature, and thereby reduces NO_x production.

Some California utility companies firing gas have successfully used low-excess-air staged-combustion and gas-recirculation techniques, and applicability to oil firing is being investigated by the same companies.

In the past, the basic question has been how to meet energy demands at minimum cost. If we modify this question to include a need for lower emissions, the technical form of the answer changes in a variety of ways.

	Fuel-burning equipment (pounds per million B.t.u.)			Nitric acid manufacture (pounds per ton)
	Gas	Oil	Coal	
Required for new sources	0.20	0.30	0.70 (575 p.p.m.)	3.0, 10 per cent opacity
Recommended for implementation plans	0.20 (175 p.p.m.)	0.30 (230 p.p.m.)		5.5 (400 p.p.m.)

For new and presently existing installations, such as power plants, classed as stationary sources of nitrogen oxides, the Environmental Protection Agency last year published the performance standards shown here (in pounds per unit of production capacity). The figures in parentheses are the approximate corresponding NO concentrations in dry flue gas containing three per cent oxygen. The author discusses the reductions that can reasonably be hoped for, as compared with the present emission levels.

However, very little work has been done to apply these combustion modification techniques to coal-fired units.

The principal problem in the use of these techniques is to reduce the NO_x emissions without at the same time significantly increasing the emissions of CO, hydrocarbons and smoke (the natural consequences of reducing oxygen supply and temperature). With coal, it is also important to avoid increasing the hazard of blowing out the fire; the suggested modifications may also increase the corrosion of boiler components and the percentage of unburnt carbon in the ash.

Cleaning the Stack Gas?

No proven process is available for removing substantial amounts of NO_x from combustion stack gases. Any wet scrubbing system for NO_x removal will be expensive, chiefly because the NO which constitutes most of the NO_x is relatively unreactive and insoluble. For an aqueous system to achieve the maximum possible rate of NO_x absorption requires that the two oxides should be present in equal amounts. This would require some method of generating NO_2 from the effluent of the scrubbing system and recycling it back into the stack gases. Alternatively, about half of the NO could be oxidized to NO_2 prior to scrubbing; but NO oxidizes only slowly (and the rate decreases with increasing temperature). Moreover, large vessels are required for scrubbing, because of the large volume of gas that must be handled and in order to minimize power requirements to move it.

Conversion of NO_x to nitrogen—using a chemical reducing agent—is in principle a possible reaction. It requires a catalyst, however, which must be sulfur-resistant if coal or oil is to be used as fuel. In any case, presently available catalysts are limited in their activity and working life, rendering this approach unfeasible as yet.

At ambient conditions, NO and NO_2 are thermodynamically unstable, so it is theoretically possible to accelerate their natural decomposition (into N_2 and O_2). However, no means of doing so at practicable temperatures has been discovered, although many catalysts have been studied for this purpose.

Finally, aqueous scrubbing systems using alkaline solutions or concentrated sulfuric acid may offer potential for removal of both sulfur oxides and nitrogen oxides from stack gas; but here too, many problems remain. So we are forced to the conclusion that the most promising prospects for significant early reduction of nitrogen oxides from electric generating plants lie chiefly in combustion modification, rather than in some hoped-for gas treatment process.

Different Kinds of Power Plant?

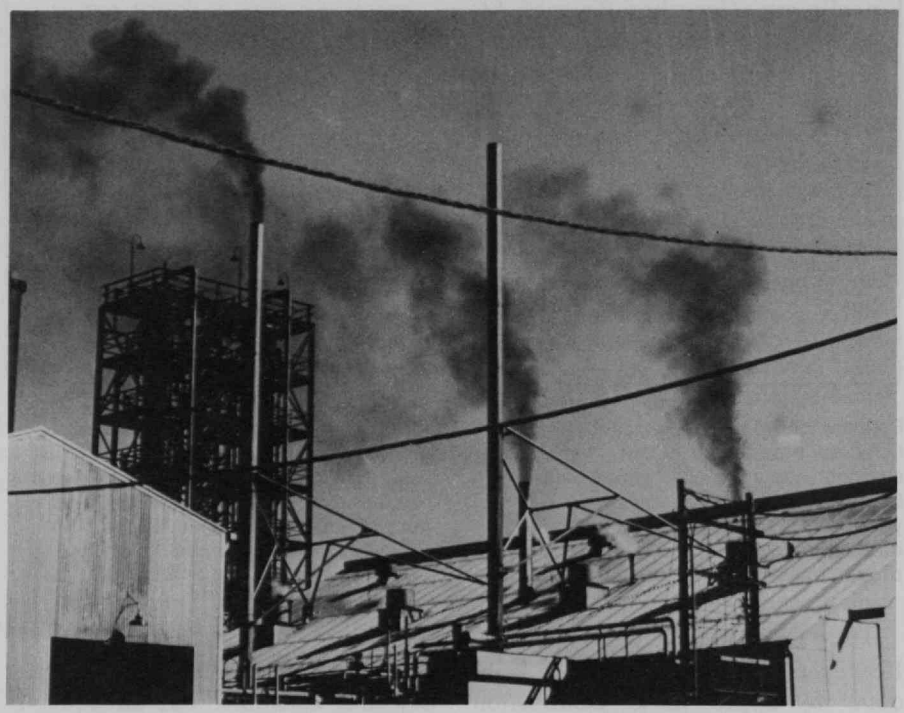
The complex problems of control of NO_x (and other pollutants) from the combustion of coal and other fuels have a number of implications for U.S. energy policy. In the past, the basic question has been how to meet energy demands at minimum cost. If we modify this question to include the considerations discussed above, the technical content of the answer changes in a variety of ways, a few of which will be mentioned here.

Fluidized-bed boilers have been studied on a small scale (see Arthur M. Squires' article in *Technology Review*, December 1971, particularly pp. 57-58) and offer potential over conventional boilers for their high heat-release rates per unit volume and high heat-transfer rates to steam tubes submerged in the bed. Coal or other solid fuel is burned at

1400 to 1800°F. in a bed of inert particles which are buoyed up (fluidized) by the incoming combustion air. NO_x formation is much less than usual because of the relatively low combustion temperature —indeed, the NO_x that is formed may come primarily from nitrogen compounds in the fuel rather than from the air. The coal particles are typically coarser than in pulverized-coal boilers, so emission of fine particulates is less; addition of limestone or dolomite to the bed may absorb most of the sulfur content of the fuel. So here is one potential high-efficiency system which indeed seems to lend itself to emission reduction.

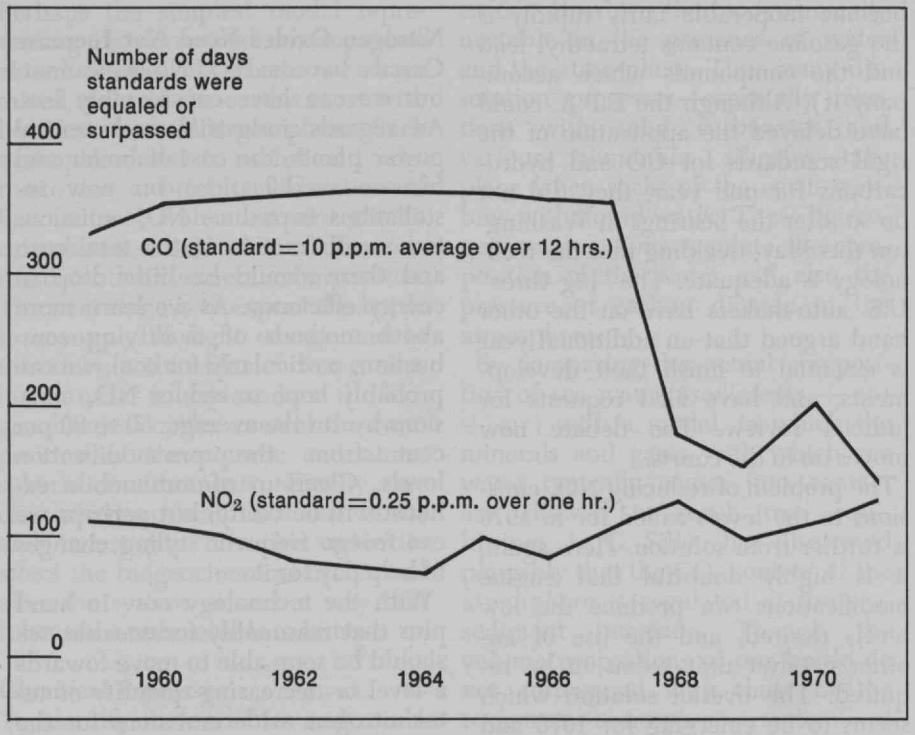
Instead of heating the boiler with coal directly, one might first "gasify" the coal and then burn the (more controllable) gas. In a reducing atmosphere, with added water or steam, coal can be made to yield a low-energy-content gas which can then be burned in a boiler or gas-turbine combustor. The quantity of NO_x formed is greatly reduced, and by operating at 10 to 30 atmospheres pressure the volume of the fuel gas can be made much less than that of the stack gases, permitting the use of modestly sized equipment for the removal of particulates and sulfur. The Lurgi process, which began to be developed in Germany in the 'thirties and uses a moving bed of coal lumps, is the only one of this kind to reach commercial scale to date (see Dr. Squires' article, pp. 54-56). However, various other processes, including some using fluidized beds, are in an advanced stage of development. Utilities are also showing interest in a variety of combined-cycle systems, in which typically a portion of the power is generated by a gas turbine and the remainder by a steam turbine, thus making better use of the whole range of available gas conditions. Some of these systems could feature coal-gasification and the purification of the resulting gas.

In fact, in 1970, about 20 per cent of the nation's electrical generating capacity was in the form of gas turbines, used to supply extra power at peak times. But these gas turbines are essentially the same as those developed for aircraft jet engines, and may be significant sources of NO_x. This problem will probably become more severe in the years ahead, as improvements in turbine materials enable the outlet temperature from the combustor to be raised—which is highly desirable from the standpoint of thermodynamic efficiency. Gas turbines operate with a great excess of air, so the NO_x produced contains a particularly high proportion of NO_2; a noticeable plume can often be seen even at NO_2 concentrations of as low as 10 p.p.m. or so because of the large size of the



This photograph was taken at one stage in the installation of catalytic NO_x-reduction units in the stacks of a nitric acid plant at Lawrence, Kansas (*Platinum Metals Review*, Vol. 12, No. 1, pp. 2-6). At this point, each stack was receiving the tail-gas from the manufacture of 120 tons/day of acid, but only the center front stack had been fitted with the catalyst; the emissions from the others are visible here due to their nitrogen dioxide content. The platinum catalyst (made by Matthey Bishop, Inc., who supplied the picture) enables the dioxide to be converted either to the monoxide or to nitrogen, both invisible, depending upon the availability of a reducing gas such as hydrogen or methane. In this case complete reduction was achieved, writes Matthey Bishop's Dr. J. B. Hunter.

If methods are developed for the extraction of nitrogen oxides from combustion effluent gases, they could have a major economic impact on the nitric acid industry—which already has its own version of the nitrogen oxides problem.



In the Los Angeles Basin, carbon monoxide levels have in recent years been reduced so that the state standard is exceeded on less than half of the days of the year, according to the Los Angeles County Air Pollution Control District *Digest*. But, the *Digest* reports, the record for exceeding the nitrogen dioxide standard is growing, if anything, worse. The District blames auto modifications aimed at more complete combustion of hydrocarbons, which at the same time made for engine conditions favoring the production of NO_x. (*Chemical and Engineering News*, 12 June 1972, p. 12)

plume. However, there is a real possibility that, by redesign of combustors and recirculation of exhaust gases, NO_x emissions from gas turbines can be reduced—especially since the stringent weight and volume limitations that apply to aircraft do not apply on the ground.

Another proposed process featuring combustion of a fuel at high temperatures is magnetohydrodynamic electricity generation. Direct-current electricity is generated by passing the combustion gases through a magnetic field, the gases being first "seeded" with potassium or cesium to render them more electrically conductive. Additional electricity is generated downstream by sending the exhaust gases to a boiler or turbine, so the overall system is highly efficient. (One can look at MHD the other way round—as a no-moving-parts high-temperature supplement to an otherwise more or less conventional power plant.) Again, significant quantities of NO_x would be generated at the high combustion temperatures, and the cost of emission control could have a major impact on the final cost of the electricity.

Moreover, if flue-gas treatment methods are developed for the recovery of NO_x from combustion, they could have a major economic impact on nitric acid manufacture; in inadvertently generating nitrogen oxides, power plants provide in a dilute form the same chemicals which the nitric acid industry provides by deliberate oxidation of ammonia. And that industry has its own version of the NO_x problem.

Oxides from Nitric Acid

Because nitric acid is chemically closely related to the nitrogen oxides, its manufacture or use generally involves some NO_x emission. The amount is small on a national basis, but can be significant locally. The high ratio of NO_2 to NO typical of such emissions results in the formation of visible colored plumes at relatively low NO_x levels.

Technology is available for the catalytic reduction of emissions from nitric acid plants, using natural gas as the reducing agent, but in much current practice most of the NO_2 is reduced only to NO rather than to N_2. This is decolorization, but not emission control. Some oxygen is also present, and in order to achieve complete reduction to N_2 all the oxygen must also be reacted. This requires a greater consumption of natural gas and close control of the process. The problem is compounded by the fact that the oxygen concentration is set primarily by plant operation requirements and may not be easily adjustable for the purposes of the catalyst unit. A reducing agent such as ammonia may convert the NO to N_2 without react-

ing with the oxygen, but careful control is still required to avoid the oxidation of some of the ammonia itself to NO_x, or the formation of ammonium compounds.

Adsorption processes, for example using "molecular sieves," are under development, and may enable NO_x emissions to be reduced to a very low level. The idea here is to use, instead of a chemical reaction, a material which under certain conditions traps NO_x molecules, and under other conditions releases them. Water vapor present in the effluent would probably have to be removed first and separately, and NO_2 is much easier to adsorb than NO, but desorbed NO_2 could presumably be returned to the plant as an input.

Automobiles: Solutions Uncertain

Control of NO_x from automobile engines must be considered in the context of the overall problem of pollution from cars. This subject is vast and complex; both the technology and the political and social climate which affect standards and enforcement may change rapidly.

Present federal law calls for a reduction of about 90 per cent from the emission levels of 1970 model cars, this to be achieved for carbon monoxide and hydrocarbons in the 1975 model cars and for NO_x in the 1976 model cars. Specifically, this calls for the emission of not more than 3.4 g. of CO and 0.41 g. of hydrocarbons per vehicle-mile. The specification in terms of vehicle-mile means that the larger and more powerful cars must achieve a greater degree of cleanup. For NO_x, emissions prior to control were about 4.0 g./vehicle-mile. This is to be reduced to 3.0 g./vehicle-mile for the 1973 and 1974 model years (2.0 g./vehicle-mile for 1974 in California) —which can be achieved by engine modifications—and to 0.4 g./vehicle-mile for 1976.

NO_x levels can be reduced somewhat by the use of the same principles as are employed or proposed for other combustion processes; thus recirculation of exhaust gas is helpful but lowers power output. Running an engine fuel-rich reduces NO_x but increases CO and hydrocarbons, so that a strategy for obtaining a major reduction in NO_x emissions must be combined with methods for minimizing emissions of CO and hydrocarbons.

Mechanical modifications designed to give more precise metering and mixing of fuel and air, such as direct fuel injection, will reduce hydrocarbon and CO emissions considerably, but probably not to the levels sought, especially in production-line cars. These emissions can be converted to harmless CO_2 and water vapor by adding air to the exhaust and passing the mixture through a catalyst. The use of catalyst units will almost certainly be required to meet the standards specified for 1975 model cars. The U.S. is moving towards a policy to make non-leaded gasoline widely available by then (all catalysts studied are poisoned or become inoperable fairly rapidly if the gasoline contains tetraethyl lead and the compounds which accompany it). Although the E.P.A. could have delayed the application of the rigid standards for CO and hydrocarbons for one year, they did not do so after the hearings in Washington this May, deciding that the technology is adequate. The "big three" U.S. auto-makers have on the other hand argued that an additional year is essential to finish their developments, and have filed requests for judicial review. The debate now moves on to the courts.

The problem of reducing NO_x emissions to the levels called for in 1976 is further from solution. Here again, it is highly doubtful that engine modifications can produce the low levels desired, and the use of another catalyst unit seems to be required. The overall solution which seems to be emerging for 1976 and thereafter is to run the engine slightly fuel-rich and allow the NO_x formed to be converted to N_2 by the reducing gases consequently present, using a selective catalyst unit. Downstream from this unit, additional air will be added, and the modified exhaust mixture passed through another catalyst bed in which the CO and hydrocarbons are oxidized. Under typical operating conditions, many of the suggested NO_x-reduction catalysts reduce much of it to ammonia rather than simply to nitrogen, however, and in the second unit the ammonia would be reoxidized to NO_x, which is less than a satisfactory solution, to put it mildly. Furthermore, there are still questions of activity and durability, as with the oxidation catalysts.

How about other prime movers? Replacing the reciprocating internal combustion engine with the Wankel engine, now available in the U.S. in the Mazda car imported from Japan, will still require catalyst units for cleaning up the exhaust to 1975-1976 levels. Gas turbines are of interest, especially for large vehicles and buses which are used for steady over-the-highway driving. Here, emissions of CO and hydrocarbons are low, but—as in aviation turbines —NO_x emissions are substantial. Steam engines are being developed by several groups. Their pollutant emissions can probably be made low, but weight and size problems remain and thermal efficiencies are somewhat uncertain.

Nitrogen Oxides Need Not Increase

Can we have no NO? No, we cannot; but we can have considerably less. As regards industrial and central power plants, the cost of boiler and furnace modifications on new installations to reduce NO_x emissions is a small fraction of the total cost, and there should be little drop in energy efficiency. As we learn more about methods of modifying combustion, particularly for coal, we can probably hope to reduce NO_x emissions by, on the average, 50 to 80 per cent from the pre-modification levels. Clean-up of automobile exhaust will be costly; but perhaps we can forego frequent styling changes to help pay for it.

With the technology now in hand plus that reasonably foreseeable, we should be soon able to move towards a level or decreasing quantity of total nitrogen oxide emissions for the next 20 years or so. And perhaps that is as far as we can realistically project.

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Concepts of Pollution and Its Control

Perhaps the simplest model representing the terrestrial envelope is a closed bottle in which we have mixed rocks of the earth's crust with liquid water and a gas phase. Such a simple model is useful and adequate for a brief consideration of how natural waters acquire chemical substances and what mechanisms regulate their mineral composition. The next stage is to expose the bottle to a supply of light energy and to introduce a thin film of living matter, in order to explore how the biogeochemical cycles control the composition of the aquatic and atmospheric environments. Finally, we can introduce man into our bottle and investigate how his activities affect the biogeochemical cycles and alter the system in such a way that it becomes unfavorable to him.

Chemical Processes

To identify the variables and mechanisms that regulate and control the mineral composition of natural waters we must understand the chemical processes involved in the interaction between rocks (the lithosphere) and water (the hydrosphere). Many constituents of the earth's crust are thermodynamically unstable in the presence of water and the atmosphere. Thus many dissolution processes—especially reactions with solid carbonates and various aluminum silicates—take place when rocks of the earth combine with liquid water. These heterogeneous reactions regulate the composition of the water and also the pressure of carbon dioxide in the atmosphere.

By comparing the actual composition of sea water (sediments + sea + air) with a model, in which the minerals and gases with which sea water typically comes into contact are allowed to reach true equilibrium, L. G. Sillén has illustrated plausibly that the CO_2 content of the atmosphere is regulated at the sea-sediment interface. Though the volume proportions of our bottle do not correspond with those of the rock-water-atmosphere system of what fittingly has been called "spaceship earth," the idea of "a gas bubble in a closed bottle" in fact reflects the mass proportions of CO_2 in the geosphere: for every carbon atom in the atmosphere there are about 60 carbon atoms in the hydrosphere (mostly as HCO_3^-) and about 40,000 carbon atoms in the sediments (largely as solid CO_3^{2-}).

Of course there is no true equilibrium in the sea or in the more transient inland waters, but such equilibrium models help us to understand some of the complexity of the real world, and they describe the boundary conditions toward which real systems have to proceed, however slowly. Furthermore, even in dynamic and open systems there exist regions or environments where equilibrium is being approached.

Heterogeneous dissolution and precipitation reactions are essential buffer mechanisms in natural waters. For example, a water that is in equilibrium with solid limestone ($CaCO_3$) will tend to maintain a rather constant solution composition even if additional calcium or acid is introduced into it. We generally recognize the truth of the oversimplified Le Chatelier statement, "A system tends to change so as to minimize the external stress;" the greater the chemical diversity of a system—that is, the greater the number of components and phases it involves—the more resistant is the system toward changes induced by external influences.

Solar Energy and the Cycles of Life

Exposing our bottle to solar radiation creates a flow of energy through the system. The flux of energy into the bottle, intercepted and partially absorbed by the atmosphere and the rock-water system, and the loss of energy from the bottle through thermal radiation, will attain a rough balance. Because the incoming radiation strikes the contents of our bottle unevenly, gas and water are set into motion. If the bottle contains organisms, our model becomes a *microcosmos*: a small portion of the light energy used in algal photosynthesis becomes stored in the form of organic material. Some of the organic matter in turn becomes oxidized, liberating energy in order to support the life processes (assimilation) of bacteria and animals.

The earth, likewise, is a "heat engine" or "entropy pump," which extracts energy from the stream of radiation—chiefly from the sun—to power the winds and ocean currents; the cycles of water, nutrients, and other elements (the hydrogeochemical cycles); and the cycles of life through the different levels of the

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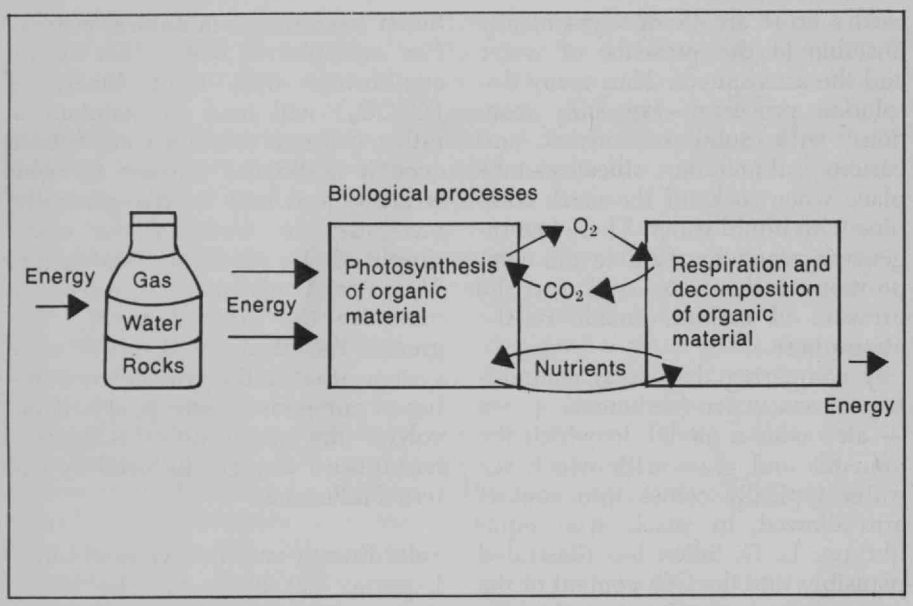
A "closed bottle" model demonstrates how ecological constraints demand that human social and economic systems move toward a stationary state, where resources and materials are increasingly recycled.



The "closed bottle" is an effective metaphoric model of the biosphere, for the earth itself is a similarly self-contained system. The chemical processes within the bottle (left) display the simplified equilibrium reactions which maintain themselves and tend to restore balances when external disturbances occur. When energy is added (right), the processes of organic growth and decomposition begin, and it is here that the "closed bottle" model has special relevance to understanding current human problems.

food-chains. Both our microcosmos and the biosphere are complete ecological systems—i.e., systems in which a biological community and its abiotic environment are interrelated and interact upon each other. In such systems the flow of energy is reflected in the trophic structure—the organization of types of food users, from the primary producers through the various levels of decomposers and consumers, each occupying its own place in the food web and in the material cycles.

Steady State and Stability Against External Perturbations

Because of the varying energy flow, systems such as we know on earth cannot be in equilibrium. But despite a constant turnover of individuals in the biological community, eventually there is attained a macroscopic balance between birth and death rates, between production and destruction of organic material, between production and consumption of oxygen. Such a macroscopic balance leaves a surplus of oxygen (chemically equivalent to the amount of organic matter in existence) in the gas and solution phases.

Can we characterize these relations and the tendency to approach a steady state by more quantitative expressions? Classical thermodynamics simply demands that natural spontaneous processes be accompanied by an increase in entropy—an increase in randomness. And indeed it may be said as well that within our microcosmos the organization of the ecosystem has been acquired at the expense of an increase in entropy throughout the external environment.

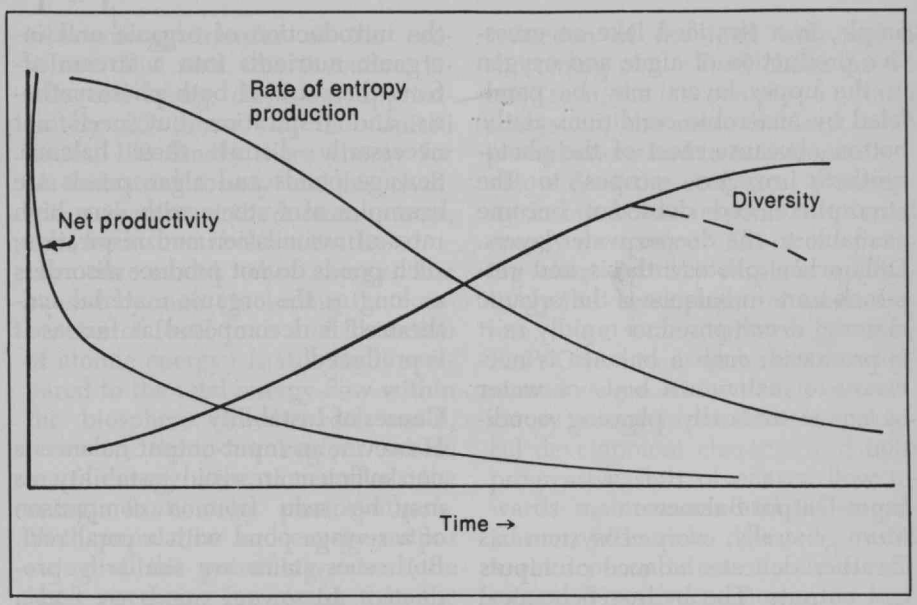
Transition from an initial transient to a stationary state involves a decrease of the rate of entropy production. The steady state may be described as one of minimum entropy production (least free energy dissipation) consistent with the presence of whatever outside influences are at work. The validity of this principle with respect to ecological systems cannot be assured, but we can infer that a stationary state has stability against external perturbations, because a system in the state of minimum entropy production cannot spontaneously move to a state of more rapid entropy production—the natural tendency is in the other direction. If as a result of some external fluctuation it deviates slightly from this state of minimum entropy production, internal changes will again bring the system to its stable state, in accordance with the above-stated principle.

Within our bottle, for example, the approach to the stationary state is characterized by a reduction in internal energy flow, resulting from various exchange losses and from the use of increasing amounts of energy for maintenance of the living organisms. Hence there results a succession of ecosystems, each one arising in the conditions created by the previous one—conditions of increasingly complex order among the life-forms and decreasing extremes in such physical circumstances as energy availability. There is a progressive increase in ecosystem organization and a general improve-

Our present industrial development and its interference with natural relationships counteracts the indigenous forces of natural selection and may cause a partial and localized reversal in evolutionary trends.

ment of metabolic efficiency.

Since life processes go on more successfully under relatively constant conditions, evolution as well as ecological succession aiming at preservation of life proceed generally in the direction of decreasing entropy and increasing regulation in order to consolidate stability. Parallel to such development is a chemical and physical evolution which tends to minimize the throughput of mineral nutrients, increasing the efficiency with which these nutrients are used and thus helping to stabilize the ecosystem against physical dearths and overdoses. (For example, a forest physically binds its soil so as to limit greatly the run-off of nutrients during heavy rain.)



The development of natural systems represents, in general, a process of moving from unstable to stable conditions. Without interference, the net productivity of such a system declines as it reaches maturity while the diversity of life forms within it increases. Hence the ratio of energy flow in the system to its total biomass gradually declines; metabolic waste is reduced, the number of different energy pathways increases, and strong selective pressure on life forms develops. Pollution may be regarded as any influence which tends to distort or reverse this progression from unstable (high entropy) to stable (low entropy) conditions, reducing the diversity of life forms (dashed line).

Pollution as Ecological Imbalance

Man's ability to adapt to a changing environment is very limited. His capacity for physiological adaptive change is narrow, and evolutionary adaptation is slow. Man evolved in a reasonably stable environment capable of resisting change and perturbation.

In a broad sense pollution has been defined as an alteration of man's surroundings in such a way that they become unfavorable to him. This implies that pollution is not solely a matter of the addition of contaminants or pollutants to the environment, but can also result from other direct or indirect consequences of man's actions.

Our present industrial development and its interference with natural relationships counteracts the indigenous forces of natural selection and may cause a partial and localized reversal in evolutionary trends. In view of man's inability to adapt to major environmental changes, pollution may thus be redefined as a disturbance in the ecological balance causing loss of stability of the environment.

Balance Between Photosynthesis and Respiration

In our bottle, we may try to disturb the balance between the rate of production (photosynthesis) and destruction (heterotrophic respiration) of organic matter. This may be done by adding either an excess of organic compounds (i.e., substances gained from carbon compounds originally buried in the sediments) or an excess of inorganic algal nutrients (e.g., phosphorus "mined" from the solid materials at the bottom of the bottle). In the first case, heterotrophic processes (decomposition) tend to dominate and dissolved oxygen may become exhausted (biochemical oxygen demand). In the second case, the immediate result is progressive accumulation of algae and plants. In either case the initial perturbation will be followed by a readjustment that ultimately will lead to a new balance. For example, algae upon death become organic material and enhance the rate of respiration.

The balance between photosynthesis and respiration may also be disturbed by a localized, physical separation of the two functions. For ex-

ample, in a stratified lake an excessive production of algae and oxygen in the upper layers may be paralleled by anaerobic conditions at the bottom, because most of the photosynthetic oxygen escapes to the atmosphere and does not become available to the deeper water layers. Only when photosynthesis and respiration are in balance is the organic material decomposed as rapidly as it is produced; such a balance is necessary to maintain a body of water in an aesthetically pleasing condition.

Input-Output Balance

More generally, every ecosystem has a rather delicate balance of inputs and outputs. The hydrogeochemical cycles of all the elements that are essential constituents of living matter and that circulate through a biosphere of relatively constant composition are necessarily interdependent. The rates of cycling have to be synchronized to preserve the relative proportions representative of the biosphere (e.g., approximate atomic ratios of carbon, nitrogen, and phosphorus as 106:16:1). Deviation from these requirements of ecosystem inputs and outputs, or the acceleration of the cycling of one element, may produce ecological maladjustments—i.e., pollution. Ecological imbalance can result, for example, when the rate of extraction of a material by man exceeds the natural rate of cycling for that material, or when the output of one product (e.g., one crop species) is maximized.

In principle, inputs and outputs of an ecosystem, and the intensity of cycling of essential elements within it, can be increased in a balanced and synchronized way without causing maladjustments. For example, the introduction of organic and inorganic nutrients into a stream affects the rates of both photosynthesis and respiration but need not necessarily disturb their balance. Sewage ponds and algae ponds are examples of systems with very high rates of assimilation and respiration; such ponds do not produce disorders as long as the organic material synthesized is decomposed as fast as it is produced.

Causes of Instability

However, an input-output balance is not sufficient to avoid instability, as may be seen from a comparison of a sewage pond with a coral reef. Both ecosystems are similarily productive. In sewage ponds we find a simple and short producer-consumer food chain of great instability. Small perturbations (e.g., shock loads or variations in light energy or temperature) cause extreme fluctuations. On the other hand, a coral reef features a complex community with a large number of energy pathways. Such systems of great diversity usually have a greater resistance to changes than systems of low diversity. Although the cause-and-effect relationship between diversity and stability is not clear, it has been shown experimentally that diversity indeed accompanies physical stability. This may become more evident from a consideration of the regulatory mechanisms in ecosystems.

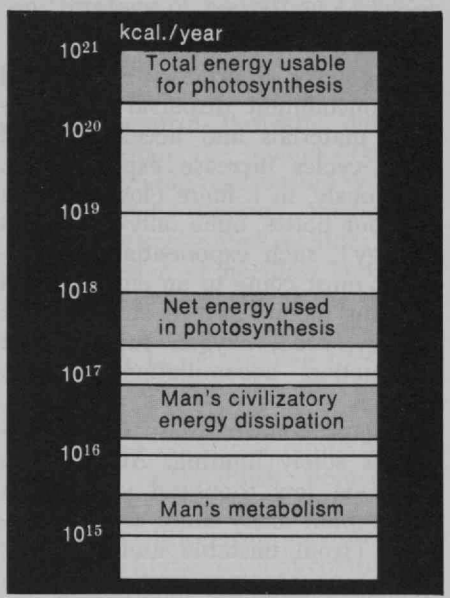
Homeostasis and Stability

Anyone who tries to regulate a reaction system by turning a multitude of valves or switches soon becomes frustrated with the instability of his experimental system and appreciative of automatic control devices. Feedback is an essential feature of such control devices. From the controlled system a signal is supplied through a feedback loop to an error detector; this generates an error signal which in turn adjusts a valve that controls the supply of a reactant. This kind of cybernetic mechanism prevails at the level of the individual organism and in groups of organisms as well as in entire ecological systems.

The word "homeostasis" has been used to indicate constancy maintained by negative feedback. Frequently a species adapts successfully, by the homeostatic mode, to a spectrum of environments. Information concerning the effects of an organism's own actions on a variable of the system is perceived and fed back to the organism, thereby altering its subsequent performance. Population homeostasis requires a similar feedback of information on whether the system is in balance and, if not, how far it is away from the balance point.

The members of a typical ecological community are interrelated by various homeostatic mechanisms. Interaction between predator and prey, for example, can be considered in terms of negative feedback regulation: a predator may eat a variety of animals, but since the most abundant kind will be caught most often, there is a sort of automatic limit on abundance for any given species.

All members of a complex ecological community play their part in cycling matter and energy. They are interlocked by various feedback loops and are thus adapted to the advantage of the system; because of the involved network of checks and balances, and the complicated food-web, each species has multiple relationships with other species in the same community and the survival



The metabolism of man (and even of all animals) represents a very small fraction of the total energy flux of the biosphere, most of which has until very recent times been in the form of photosynthesis. But now our increasing exploitation of stored energy in fossil and nuclear fuels makes this a significant factor in the total, and in some areas of the globe man's energy use now exceeds the energy fixation by photosynthesis.

of the system as a whole is promoted.

Man Against Nature

Man is an integral part of the ecosphere; thus, in our model, he is inside the bottle. Despite the fact that man attains high population densities in some areas, the human animal plays a relatively minor role in the overall physiology of the biosphere. The amount of energy involved in man's metabolism is small in comparison to the total energy fixed by plants; likewise, man's wastes play a negligible role in the total energy transfer of the ecosphere. But man, the inventive intellectual being, dissipates approximately 20 times (in the United States, 100 times) more energy for his industrial society and his civilization than man, the human animal, does for his metabolic activities.

In our model, the energy flux caused by man (including the combustion of fossil fuels and liberation of atomic energy) is still small compared to the total energy flow within the biosphere. In the real world, however, there are regions where man's energy utilization exceeds the energy fixation by photosynthesis. With population and energy output rising at the prevailing rates (the latter rise being far greater than the former) man's energy dissipation will within a few generations (there being no limit in nuclear energy resources for the foreseeable future, given successful exploitation of breeder and perhaps fusion reactors) exceed the biological energy flow. The stress imposed upon the environment as a direct or indirect result of the civilizatory energy dissipation outweighs by far the disturbances caused by the disposal of human domestic wastes.

Ecological Disruption and Succession

Energy dissipation can cause pollution in many different ways. Much of our present attention is upon the direct consequences of energy utilization; most of our concern in the future should be with the fact that most of the energy dissipation by our industrial society for its own advantage (agriculture, manipulation of landscape, urban construction and other consequences of civilization) ultimately causes a simplification of the ecosystem, specifically a reduction of the food web and a shortening of the food chain. As we have seen, the less complex a natural ecosystem, the more liable it is to perturbations and to catastrophe.

How does the ecological community in our bottle respond to internal energy dissipation? The accompanying chart (p. 21) displays qualitatively the development of an ecosystem, using some attributes given by E. P. Odum to describe the developmental stages. At low levels of civilizatory energy input there is ecological development characterized by a progressive shift of energy flow towards maintenance and self-organization, ultimately directed toward a state of optimum metabolic efficiency. Thus, succession is to ecology what evolution is to general biology.

As bioevolution leads toward increased complexity of order, ecological succession is directed toward a community of high diversity, maintaining a stationary state which we term a climax community. During this development, organisms show a decrease of entropy production, attaining at steady state (climax) the least production of entropy (per time and mass unit) compatible with the particular constraints of the system.

An increase in the energy flux within the bottle, simulating man's interventions, enhances entropy production. Many homeostatic mechanisms are destroyed, and the result is a different community of simplified and less stable structure with higher net productivity.

For example, our progress in agricultural food production has been accomplished by pumping auxiliary energy (mechanical energy, heat, and/or chemical energy in the form of organic and inorganic nutrients)

Direct consequences from energy dissipation	On land—solid wastes; land disturbance; heat rejection. On water—oil spills; radioactive wastes; heat pollution; evaporation. On air—sulfur, nitrogen and carbon oxides, hydrocarbons; injection of dust and condensation nuclei into atmosphere; heat rejection; depletion of solar radiation, change in microclimate.
Increased production of industrial materials	Acceleration of hydrogeochemical cycles. Disturbance of input-output balance. Accumulation of toxic materials (metals, hydrocarbons, H_2S). Overproduction or depletion of biochemically essential substance. Eutrophication.
Simplification of ecosystem	Disordering and disintegration of biosphere. Curtailment of food web and food chain. Reduction in diversity. Disturbance of balance and loss in stability. Counteraction of forces of natural selection.

This table summarizes some of the many different ways energy dissipation can cause environmental impairment. "Most of our concern in the future should be with the fact that most of the energy dissipation by our industrial society for its own advantage ultimately causes a simplification of the ecosystem, specifically a reduction of the food web and a shortening of the food chain. . . . The less complex a natural ecosystem, the more liable it is to perturbations and to catastrophe," the authors write.

through the system. By clearing land, by planting crops, and by controlling weeds and pests and other competitors, a monoculture of high productivity but of high instability is established. An unstable soil system leaks nutrients and pesticides to the water and accelerates erosion. It is not possible to maintain side by side a productive unstable soil system and a non-productive stable aquatic environment.

Woodwell has shown that many types of environmental disturbances (chronic irradiation, fire, exposure to sulfur dioxide, and pollution by pesticides, hydrocarbons, heavy metals, or excess nutrients) cause similar and roughly predictable gross changes in ecosystems; the chart on page 21 is well suited to generalize pollutional effects: in each case there is a shift towards an increase in entropy production (or loss of structure), away from complex arrangements of specialized species toward the generalists, away from diversity toward monotype, away from tight nutrient cycles toward loose ones with terrestrial systems becoming overloaded, away from stability toward instability.

What Limits the Exponential Growth?

The flow of civilizatory energy and its concomitant dispersal of industrial materials and acceleration of food cycles increase exponentially. Obviously, in a finite closed system (as our bottle, open only to radiant energy), such exponential development must come to an end. Various limiting factors have been proposed: energy, food, oxygen supply, heat production, accumulation of toxic wastes.

Perhaps none of these factors becomes solely limiting. At least for the next few thousand years, man can exploit many times as much energy (from unstable atoms in our rocks) as becomes fixed in photosynthesis. Today, oxygen consumption exceeds oxygen production only locally. Because of our large oxygen reserves and of regulatory mechanisms that tend to restore the oxygen balance, oxygen is unlikely to become limiting. With abundant energy available, global food production can be accelerated sufficiently to keep pace with population growth despite local famines. Radioactive wastes and other toxic products can be stored in salt mines of sufficient capacity for another few thousand years.

A significant factor that might slow growth is the relative increase in entropy production; this will make increasingly difficult the maintenance of the specialized type of organization that is needed for a complex society of high population density. This disordering of natural systems is equally implied in ecological instability. We may thus have to anticipate environmental fluctuations resulting from the simplification of biological structure, from the accumulating byproducts of human

action, and from accelerating and uncoupling of hydrogeochemical cycles; these, together with failures from decreased level of organization as well as social and psychological disorganization, will progressively disrupt our environment and interfere with the quality of man's life. Sharp local and temporal transients and catastrophes may be induced.

Pollution Control

Given the conflict between resource exploitation and pollution control, can we now work out concepts of pollution control that can be converted into practice? In his paper on "Strategy of Ecosystem Development," (*Science*, Vol. 164, p. 262) E. P. Odum provides a most important basis for evaluating measures of control. Basically, our goal is to maintain the human organization in a viable relationship with the environment. Various means for stabilizing ecosystems include:

☐ Reduction of needless consumption of resources and of the flow of industrial materials by process recycling or by channeling these materials into the slowest possible hydrogeochemical cycles.

☐ A more conscious effort to preserve or re-establish homeostatic mechanisms and population diversity and to lift certain environments towards a higher level of complexity.

☐ A conscious attempt to maintain input-output balances and to refashion a food cycle where starvation as well as pollution are minimized.

Because pollution is characterized by instability, a non-polluted environment is one which resists perturbation. Although such a system is not too far away from a stationary state, it is not necessarily an unchanging one; ideally it is a life-supporting system in which the cycling is controlled and energy flows are decreasing. In such a system increasingly complex checks and balances are developing, diversification is increasing, and instability is giving way to stability.

But the energy flow and entropy production of our present civilization are already too large to maintain the entire ecosphere in a stable non-polluted state. E. P. Odum therefore makes this suggestion: Partition our environments into separate compartments of high productivity (growth systems), high diversity (mature protective diversified life support systems), and urban industrial regions. Preferably these regions should be isolated from each other because entropic activities necessary to maintain monocultures of high productivity (plowing, seeding, fertilizing, irrigation, pest control, etc.) counteract measures designed to keep neighboring ecosystems in a non-polluted, stable state.

The oceans and most fresh water systems are well suited as protective diversified rather than as productive ecosystems. The boundaries between productive and non-productive systems are more mobile in aqueous systems. Moreover, the rate-determining steps in the hydrogeochemical cycles of most elements lie in the regulatory mechanisms of the sea. On land, fresh water systems often are able to slow down individual loops of the elemental cycles. Hence, keeping aquatic systems at low rates of production, decomposition, and nutrient regeneration tends to slow down the hydrogeochemical cycles, or some of their loops, and thus to stabilize terrestrial as well as aquatic environments. The inflow of nutrients into a lake keeps it in a highly productive state of low maturity. Eutrophication can be reversed—the succession can be forced away from eutrophy in the direction of oligotrophy (the nutrient-scarce condition) and high diversity, by sharply curtailing the input of nutrients into a lake.

Water pollution control does not consist solely of waste treatment; various physical and biological means of stream management may be directed towards restoring an ecological balance. The table on this page lists some examples of corrective measures. Our "closed-bottle" model makes clear that zoning of land in the watershed, in particular the restriction of land use in the corridor adjoining the surface waters so as to give preference to diversified ecosystems with long food chains, is among the most powerful measures for water pollution control.

Reducing ecological stability in water	Promoting ecological stability in water
Increase of energy flow: Disposal of nutrients. Mixing (destratifying, sediment dredging, etc.), Heat disposal Imposing turbulence	*Photosynthesis/Respiration balance* Reducing waste input, Harvesting or washing out of biomass, Reducing relative residence time or *restoration:* trapping of nutrients, Mixing (bringing P and R together), Fish management, Aeration.
Exploitation of adjacent soil: Crop growing, seeding, weeding and grazing, Fertilizing and irrigating, Deforestation, Converting grassland into cropland, Applying herbicides and pesticides.	*Conservative land management:* Reforestation, Restricting monoculture productivity, Zoning (maintaining zones adjacent to open waters which are kept free of fertilizers and of low net productivity), Controlling erosion, Using detritus agriculture.
Reduction of structure: Using algicides, Destruction of niches (removal of reeds), Episodical physical perturbations (flushouts, temperature discharges, shock loadings), Excessive harvesting, Disposal of non-natural chemicals, Selective harvesting, Interference with chemostasis.	*Enhancement of biological complexity:* Establishment of ecological niches (zones, waterfront development), Seeding diverse populations and recirculating certain organisms, Maintaining relatively high biomass compatible with energy flow, Maintaining stratification, Maintaining high chemical buffer intensity (weathering of rocks).

Many alternatives are available to us for improving the quality of water in streams, lakes, and oceans; our goal in every case is to promote stability by balancing the input and output of energy and materials. The alternatives on the left are those which tend to bring instability either in the short or long term; those on the right the reasonable ways to increase stability—which in many cases can be accomplished without decreases in the rates of assimilation and respiration.

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Strategic Stability, with S.A.L.T.

"Mr. Chairman, I think it is wrong to ask who 'won' or 'lost' the initial S.A.L.T. negotiations. . . . Both sides must gain from S.A.L.T. or neither side does."
(From the statement of Secretary of of State W. P. Rogers to the Senate Foreign Relations Committee in support of the S.A.L.T. agreements, June 19, 1972.)

The Moscow agreement signed by President Nixon on May 26, 1972, signaled the end of two years of laborious negotiations between the United States and the Soviet Union known as the Strategic Arms Limitation Talks (S.A.L.T.). It is an agreement that required political courage and diplomatic skill to conclude. But its stimulus was a saturation effect that minimized the advantage of any superiority in the quality and quantity of the strategic weapons in the arsenals of either country.

This article attempts to illuminate this saturation effect by examining the existing strategic weapons, their performance characteristics, and the various modes of usage that they admit. It will try to show that the key result of the S.A.L.T. talks is the acceptance of a new strategic concept that seeks national security not in nuclear superiority nor in nuclear disarmament, but in a balance of strategic power that leads to *strategic stability.* (A second article, to be published in the December issue, will investigate the weapons system that is best suited for this policy of strategic stability, and the technological developments in the continuing portion of the arms race that may threaten it.)

A strategic weapon is aimed at destroying the long-term ability of an adversary to wage war, or at preserving that ability for one's own forces. Offensive strategic weapons, then, are not for use in tactical combat but against such targets as industrial production or population centers or the adversary's targetable strategic weapons systems. In turn, defensive strategic weapons aim at protecting the industrial capability of a country, its population or command centers, and its ability to wage offensive strategic warefare.

What the Weapons Are

Strategic weapons, both offensive and defensive, are classified into three categories: airborne, ballistic, and orbiting. The airborne weapons are more or less passé. They are less and less relied upon as parts of a strategic force. Orbiting weapons, such as satellites, are still in the future; treaties have forbidden satellites as offensive weapons and they are used mainly for inspection of other nations. In contrast, the weapons based on the principle of ballistic motion form the central components of the offensive and defensive arsenals of the United States and the Soviet Union. Consequently the following discussion will concentrate only on weapons systems that employ ballistic missiles to deliver a nuclear warhead.

A ballistic missile is a projectile that, after receiving an initial impulse, travels freely under the influence of gravity in a plane that is defined by the launch and target points and by the center of the earth. It consists of a booster section and a re-entry vehicle. The booster section, usually divided into two or three stages, contains the propellant fuel; the thruster engines; and a guidance system consisting of an inertial platform, computer, clock, and mechanisms that control the flow of fuel to the thruster engines. The re-entry vehicle contains the nuclear warhead, its ablative shield, and the fusing and arming mechanisms.

If a missile is equipped with a multiple independently targetable re-entry vehicle (M.I.R.V.), the re-entry vehicle has its own guidance system and propulsion vernier jets and contains several (3 to 14) individual warheads, each of which is aimed and shot off separately and reaches its target by following a ballistic trajectory. Since the accuracy of the missile is governed by the power-boost phase of the flight, warheads so dispatched have the same accuracy as ordinary missiles. However, since they are all carried by the same "bus" they cannot be dispersed arbitrarily. The down-range spread of such independently targeted warheads varies between 50 and 300 miles; their lateral spread is somewhat smaller.

And How Efficient They Are

The destructive effectiveness of a

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The World War II photographs which accompany this article show (right) the results of Allied bombing of Cherbourg; the Germans' destruction of Aachen as a defense measure (p. 31); and Hiroshima —the first nuclear strike, and one without fear of nuclear retaliation (p. 33). (Photos: Keystone View Company, H. Armstrong Roberts, Ewing Galloway).

S.A.L.T. I established that strategic stability—rather than national superiority in weapons—fosters security and that disarmament can be beneficial to that security: novel principles, and a good start.

What *we* have and what *they* have are catalogued to the right. The Minutemen and Polaris/Poseidon Missiles are our land- and sea-based missiles, respectively; the SS and SS-N series respectively are those of the Soviet Union. The mammoth warhead carried by the SS-9 is apparently a response to our more flexible M.I.R.V.s. But many smaller warheads are far more efficient, as the table (bottom near right) demonstrates: for various types of targets, what can be destroyed by either 10 small warheads or by one large one is catalogued.

ballistic missile against a target depends on the energy yield of its warhead, the accuracy with which it can be guided to the target, and the reliability with which it performs when fired. The size of a nuclear warhead is expressed as the T.N.T. equivalent of the energy it releases when it explodes. For example, a one megaton warhead releases an amount of energy equal to that produced by the simultaneous detonation of one million tons of T.N.T. The accuracy of a missile is expressed by its "circular error probability" (C.E.P.): the radius of a circle centered at the target in which 50 per cent of n warheads aimed at the target would fall, where n is a very large number.

The C.E.P. of the land-based U.S. missiles is about 1,000 ft. and of the sea-based missiles less than 2,500 ft. The land-based U.S.S.R. missiles have a C.E.P. on the order of one mile; their submarine-launched missiles are even less accurate.

Comparison of the tables at the right indicates that the U.S. has at the present time an enormous advantage in number of warheads, range of sea-based missiles, and missile accuracy, while the Soviet Union possesses more missiles with larger warheads but lower accuracy. We see that a large warhead is "wasteful" compared with the same megatonnage divided among a number of smaller warheads—in the latter case the destructive energy is more efficiently distributed. (This is clearly shown by the table at the lower right.) Thus the huge U.S.S.R. SS-9 missiles appear to be an attempt to compensate with size of warhead for the fact that the Soviet missiles are not equipped with M.I.R.V.s.

The only active defensive strategic weapon is the antiballistic missile

U.S.S.R. Land-based Missiles

Designation	SS-7	SS-8	SS-9	SS-11	SS-13
Number:	200	200	300	950	60
Range (miles):	5,700	5,700	9,000	5,500	9,500
Warhead:	5 Mton.	5 Mton.	25 Mton.	1 Mton.	1 Mton.
First deployed:	1961	1963	1965	1966	1968
Maximum length (ft.):		80	114		66
First stage diameter (ft.):		9	10		6.5
Weight at launch (lbs.):	——	——	——	——	——
Number of stages:	2	2	3	3	3
Total warheads:	200	200	300	950	60
Accuracy:	——	——	——	——	——

U.S.S.R. Sea-based Missiles

Designation	SS-N-4	SS-N-6 (Yankee-class)
Number:	42	400
Range (miles):	300	1,500
Warhead:	1 Mton.	1 Mton.
First deployed:	1961	1969
Length (ft.):	45	40
Weight at launch (lbs.):	——	——
Diameter (ft.):	6	6
Number of stages:	2	2
Total warheads:	42	400

Large Versus Small Warheads

Type of Target Destroyed	10 50-Kton. Warheads	1 10-Mton. Warhead
Airfields	10	1.0
Hard missile silos	1.2-1.7	1.0
Cities 10^5 population	3.5	1.0
Cities $5 \cdot 10^5$ population	.7	1.0
Cities $2 \cdot 10^6$ population	.5	.6
Total megatonnage	.5	10.0

U.S. Land-based Missiles

Designation	Minuteman I	Minuteman II	Minuteman III
Launch weight:	$29.5 \cdot 10^3$ kgr.	$31.8 \cdot 10^3$ kgr.	$34.5 \cdot 10^3$ kgr.
Length:	16.1 meters	17.9 meters	17.9 meters
First stage diameter:	1.65 meters	1.86 meters	1.86 meters
Speed at end of powered flight:	($25.2 \cdot 10^3$ ft/sec.) 7.55 km/sec.	7.55 km/sec.	7.55 km/sec.
Range:	$8 \cdot 10^3$ km.	$13.4 \cdot 10^3$ km.	$\sim 14 \cdot 10^3$ km.
C.E.P.:	2.2 km.	Less than 1 km.	Less than .5 km.
Re-entry vehicle:	Single warhead	Single warhead	M.I.R.V. with 3 warheads
Warhead size:	One Mton.	Larger than one Mton.	.2 Mton:/three warheads
First deployed:	1961	1964	1969
Deployment completed:	1965	1967	1974-75
Number deployed in 1970: in 1974:	 $\sim$400 None	 $\sim$600 400	 $\sim$30 600
Phase-out date:	1973	1974-75	——
To be replaced by:	M.M.-II	M.M.-III	Advanced I.C.B.M.
Total number of warheads 1974:	——	400	1800

U.S. Sea-based Missiles

Designation	Polaris A-1	Polaris A-2	Polaris A-3	Poseidon
Missile length:	8.35 meters	9.3 meters	9.3 meters	10.2 meters
Launch weight:	$15 \cdot 10^3$ kgr.	——	——	$30.0 \cdot 10^3$ kgr.
Diameter:	137 cm.	137 cm.	137 cm.	183 cm.
Speed at end of burn:	6.84 km/sec.	6.8 km/sec.	6.8 km/sec.	6.8 km/sec.
Range:	2,140 km.	2,700 km.	4.500 km.	5,000 km.
C.E.P.:	——	——	$\sim$2 km.	Less than 1 km.
Re-entry:	Single warhead	Single warhead	3 M.I.R.V. and penetration aids	10-14 M.I.R.V. warheads
Warhead size:	.8 Mton.	.8 Mton.	200 Kton.	50 Kton.
First deployed:	1959	1961	1964	1971
Completed deployment:	1961	1964	1967	——
Total in service 1972:	——	10	24	7
Total number of warheads 1972:	——	160	24x16x3 = 1072	7x16x10 = 1120

system (A.B.M.). An A.B.M. system consists of five major components: the perimeter acquisition radar (P.A.R.), the missile site radar (M.S.R.), a large digital computer, the Spartan missile with a range of 400 miles and a 1 Mton. thermonuclear warhead, and the Sprint, a smaller missile capable of acceleration to 100 g., with a nuclear warhead.

The P.A.R. is a long range radar designed to detect an incoming ballistic missile about 100 miles above the horizon, when it has entered the free-flight portion of its trajectory, and to provide trajectory information to the computer. Under the assumption that the missile has no post-boost maneuverability—which is *not* the case with M.I.R.V.s—the computer calculates the trajectory of the missile and fixes an anticipated intercept point high above the atmosphere. The M.S.R. radar takes over at this point and guides a Spartan missile to the intercept point, where the Spartan warhead explodes and destroys the incoming missile with an intense flux of soft X-rays. If the incoming warhead escapes the Spartan, the M.S.R. guides a Sprint against it. The Sprint is designed to destroy the incoming warhead with an intense neutron flux. The United States has under construction such an A.B.M. system near the Grand Forks Air Force Base in North Dakota which houses 150 Minuteman II missiles. The Soviet Union has an A.B.M. system encircling Moscow. A second U.S. A.B.M. system was under construction near another Minuteman II base in Malmstrom, Montana, at the time of the Moscow agreement. It is generally agreed that the introduction of M.I.R.V.s and the use of decoys and penetration aids severely limits the efficacy of the A.B.M. system against a large scale nuclear attack. Apparently as a result of this realization the Soviet Union abandoned further work on its A.B.M. several years ago.

Equality Gives Stability

Countries amass arsenals of weapons expecting that their military might can be transmuted to political advantage in their international relations. Consequently a weapons system, no matter how formidable, is worthless unless its use has some ultimate political utility, or its existence creates a psychological climate favorable to the country that possesses it. But, in the case of strategic nuclear weapons we encounter a paradox: as soon as more than one country possesses nuclear warheads and the means of their delivery, their political utility disappears and their psychological impact is, if anything, universally unfavorable.

Consider as an illustration two large industrialized countries, A and R, at three consecutive evolutionary stages of their strategic arsenals. In the first stage both countries possess an equal number of land-based missiles, n, which is 10 times the number of all cities with population over 200,000 in each country. Each missile is assumed to have such accuracy and warhead size that it can destroy a hostile missile in its silo with a probability of 0.9. In the second stage, A and R acquire submarine based missiles, $n/3$ of them. In the third stage both countries arm their land- and sea-based missiles with M.I.R.V.s and start installing A.B.M. systems to protect their cities from nuclear attack. To what kind of use can these weapons be put and what political utility can one expect to derive in each of these stages?

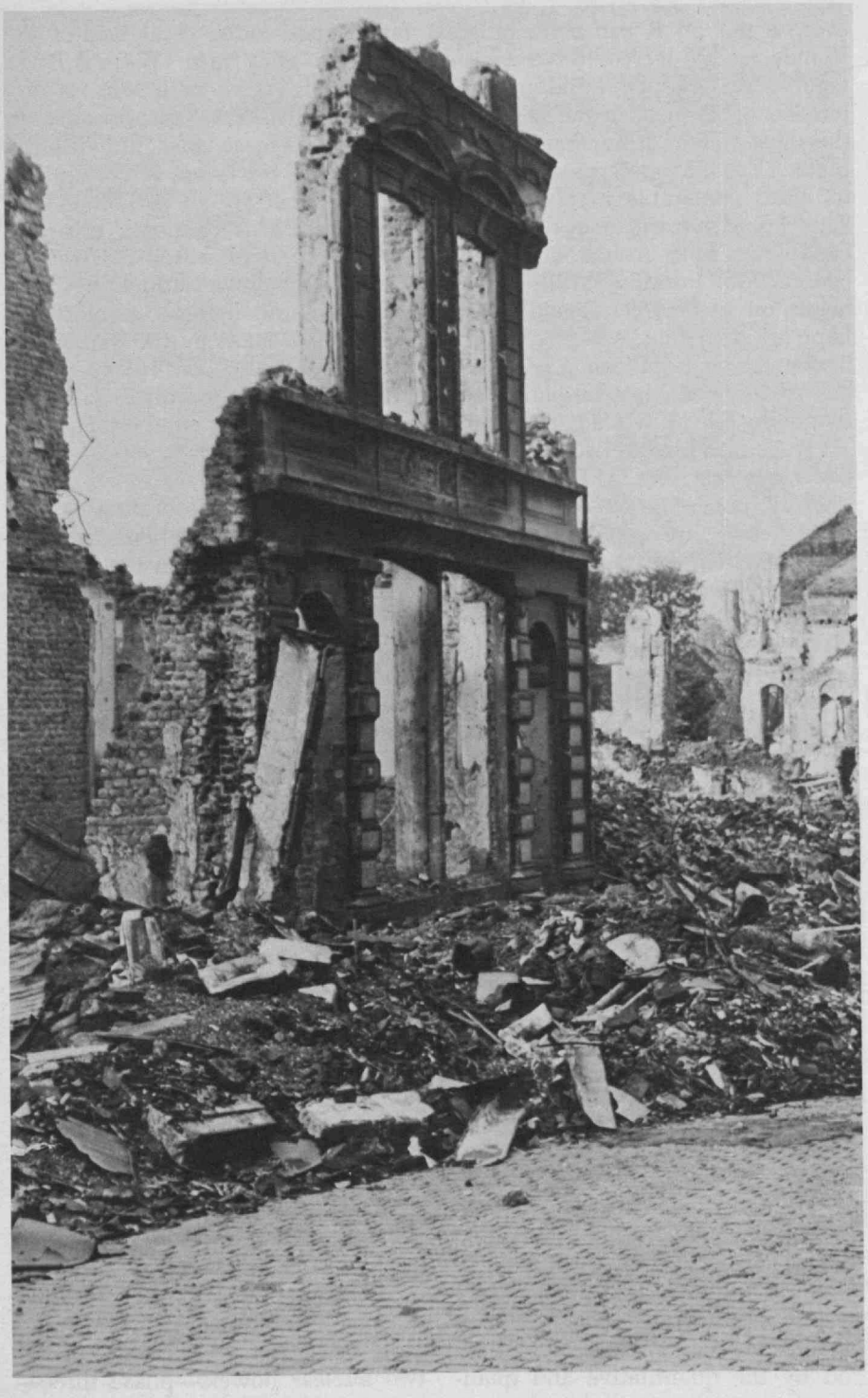
In the first stage a country has two choices of posture: it can pre-emptively strike first to knock out the other's missiles, or it can use the threat of its missiles to deter the other country's using its own. Deterrence is a very stable situation. A country, for example A, targets its missiles against the opponent's cities and waits. If the opponent R attacks A's cities, A launches its missiles against R's cities and causes politically unacceptable damage. This deters R from striking. If R decides to attack not A's cities but its missiles, in a pre-emptive first strike, again A can wait out the attack. Each of R's missiles has 0.9 probability of destroying its target, so when R has used all n of its missiles, and finished its attack, R has destroyed no more than $0.9n$ of A's missiles in their silos. A still has enough missiles to destroy at its leisure all of R's cities —an unacceptable result for R.

A first strike posture at this stage of armament does not necessarily upset the stability of the situation since it is impossible to attempt it without suffering politically unacceptable destruction of production and population centers. Balanced nuclear arsenals, according to the conditions of stage one, yield a stable situation: the leadership of each country is deterred from hostile action against the other by the certainty and enormity of the anticipated destruction. Nuclear weapons in this instance act like a large inertial mass: their presence makes it extremely difficult to start a war, but by the same principle makes it equally difficult to stop one once underway.

Help from Polaris

The second phase of building an arsenal, in which both A and R also

A weapons system, no matter how formidable, is worthless unless its use has some ultimate political utility or its existence creates a psychological climate favorable to the country that possesses it.



possess submarine-based missiles, is even more stable since the temptation of a first-strike is eliminated. Once submerged, a missile-carrying nuclear submarine is practically undetectable and therefore non-targetable. This simple property of the submarine dooms to failure any effort to achieve a credible first-strike capability against an opponent's offensive strategic weapons, either by improving the accuracy and warhead yield of one's own missiles or by trying to outnumber the other country's land-based missiles.

If, for example, R achieves numerical and qualitative superiority in land-based missiles over A, so that it can attack A's missiles in their silos—and not only destroy all of them but also be *a priori* certain of such success—R still has no hope of turning this success into political advantage. Its cities are still hostage to A's non-targetable submarine-based missiles. Once again A can wait out the attack against its missile silos.

At this point both countries have their cities intact and enough submarine-based missiles to deter each other from a politically meaningful attempt against population centers. The elimination of the land-based missiles from both arsenals does not alter either the deterrence capability of the two countries or the stability of the situation. Possession of submarine-based offensive strategic missiles eliminates the danger of total annihilation of one's deterrent offensive arsenal, so the possibility that during a period of international crisis and tension a nation may launch offensive weapons out of fear of a first-strike by the opponent becomes unnecessary and unlikely. Because one can wait to retaliate, an accident due to faulty information becomes also unnecessary

and unlikely.

The A.B.M. Enters to Undermine . . .

This encouragingly stable situation is completely overturned during the third phase of armaments with the introduction first of A.B.M.s and then of M.I.R.V.s. It must be said at the outset that there are "bad" A.B.M.s and "indifferent" A.B.M.s, depending not on performance but on what the anti-ballistic missile system is intended to protect. As the following scenario will illustrate, an A.B.M. designed to protect cities is "bad" since it abbreviates the deterrence value of nuclear weapons, puts a premium on first-strike, and thereby creates what is known as "strategic instability", which accelerates the arms race. On the other hand, an A.B.M. designed to protect missile silos further diminishes the possibility of a successful first-strike and will be shown to increase stability.

Consider the position R finds itself in if A installs an A.B.M. system to protect its cities. R cannot now use its missiles against A's cities and therefore cannot deter A from attacking with politically advantageous results. R can however limit the damage A can inflict by destroying A's land-based missiles in a preemptive first-strike. Now there is a premium in a sudden attack on A. But A knows that too, so—especially in time of international crisis—rather than wait out an attack on its missile silos, it waits for the radar signature of ballistic missiles coming over the horizon with its finger on the launch button of *its* missiles. This causes the second type of instability that can lead to nuclear war, known as "crisis instability."

A damage-limiting first-strike, however, is not all R can contemplate. It may try to overcome A's advantage in A.B.M.s by building more missiles of its own, in the hope that the sheer weight of numbers will deplete A's A.B.M. defenses and make its cities vulnerable to R's missiles. This would restore some deterrence capabilities to its arsenal. R may also counter A by installing M.I.R.V. warheads on its missiles, again in the hope of depleting A's A.B.M.s. Or finally R can install an A.B.M. system of its own. Most probably, motivated by fear, R will do all three.

It is A's turn now to become fearful and uncertain. R's M.I.R.V.s may, after all, not be targeted against A's cities which are protected by the A.B.M. system, but against A's missile silos. Since the accuracy of an independently targeted warhead is as good as that of the missile that boosted it into trajectory, R now has a good chance of destroying A's land-based strategic force by aiming several independent warheads at each of A's silos; R might even penetrate A's unpredictable A.B.M. system. A does not have the certainty of retaliation against R's cities with its submarine-based missiles any more because R's cities are now also protected with an A.B.M. of equally unpredictable performance.

Neither A nor R at this point have gained any advantage. They do not know how effective each other's A.B.M. systems are, but both make conservative assumptions out of fear. They have increased their offensive arsenals by an order of magnitude since phase two—but because of their now totally unstable situation their national security is decreased. A and R have destroyed their strategic stability by the elimination of deterrence as a strategic posture, and by the quantitative and qualitative open-ended escalation of the offensive arms race. With A.B.M.s and M.I.R.V.s on both sides, a preemptive first-strike has become attractive since it may diminish an opponent's offensive force until it cannot penetrate an A.B.M. system any more. This creates a crisis instability for two reasons: a country cannot wait out an attack, not only because its retaliatory capability has been abbreviated by the opponent's A.B.M.s but also because a successful first-strike now carries the premium of limiting the damage an opponent can inflict.

. . . for It Leads to Saturation

At this point a saturation effect appears: vast increases in the number, accuracy, or yield of a country's offensive weapons have little or no effect on the potential political outcome of a conflict with another nuclear power bent on countering these increases. What is politically significant is not the absolute amount of damage one country can inflict upon another but the difference between the damage a country can cause to its opponent and the damage it would suffer from its opponent in return.

Yet this "damage differential"—no matter how favorable—is irrelevant, for it is politically unacceptable if the damage suffered is not close to zero. Since each country has a finite number of targetable population centers, and since an A.B.M. system that protects them, no matter how efficient, can be overwhelmed, the number of offensive warheads available to a country does not affect either of the above two conditions of political acceptability. The simultaneous introduction of A.B.M.s and independently targeted warheads by two nuclear powers—phase three—

Yet this "damage differential"—no matter how favorable—is irrelevant, for it is politically unacceptable if the damage suffered is not close to zero.

decreases the security of both nations: it causes instabilities and leads to an ineffectual arms race since a saturation effect decouples increases in armaments from any political advantages.

The source of the paradoxical nature of nuclear weapons that was introduced on page 5 of this article has now become apparent. Nuclear weapons, if available to two or more nations with symmetrical technologies, are at best unusable and at worst security-limiting for the countries that possess them, regardless of how accurate their means of delivery are. Therefore, no technological effort in the foreseeable future can result in a strategic superiority of one such nuclear country over another with a tangible political utility.

A., R., and S.A.L.T.

The nuclear arsenals of the United States and the Soviet Union were entering a stage like the hypothetical third phase examined in this article, when the S.A.L.T. talks were concluded with the signing of the Moscow agreement. The Russians had installed an A.B.M. system of questionable efficacy around Moscow, a fact that promptly animated the successful American effort to arm the Minuteman II and Polaris-based missiles with M.I.R.V.s. In response the Russians increased the number of their land-based missiles, pursued a crash program of submarine-based ballistic missile construction, and started tests in an effort to develop M.I.R.V.s. In the meantime this country was wise enough to reject the "bad" A.B.M. system proposed by the Johnson administration ("Sentinel"), but it did start installation of the "indifferent" ("Safeguard") system of the Nixon ad-

ministration. "Safeguard" did not at that time exacerbate the instability of the situation, but it did not contribute any security either: as in the hypothetical second phase we analyzed, the Polaris-based missiles deny the Russians the possibility of a meaningful first-strike against the Minuteman force. Safeguard was not "bad": merely a waste of money.

By the beginning of 1970, however, it was clear that the arms race spiral and the saturation effect facing us were going to become an unmanageable reality unless the United States and the Soviet Union entered negotiations designed to dampen the uncontrolled proliferation of unusable yet destabilizing weapons systems. The resulting Moscow agreements—a treaty limiting A.B.M. and a protocol agreement regulating offensive weapons—are the fruits of these negotiations.

What S.A.L.T. Does

The A.B.M. treaty provides that each country can deploy one A.B.M. system involving 100 Spartans and 100 Sprints around its capital city, and another one to protect a field of intercontinental ballistic missiles. In addition, it provides that neither country will attempt to develop exotic (sea-, air-, or space-based) A.B.M.s; neither will it try to upgrade the allowed two systems. The Interim Agreement on offensive weapons freezes for five years at the present levels the totals of land- and sea-based missiles each country possesses. It allows the further equipping with M.I.R.V.s of Minuteman and of Polaris-based missiles, but forbids the construction of additional land-based missiles or the conversion of older and smaller land-based missiles into more sophisticated models. The Soviet Union is allowed 720 submarine-based missiles and therefore a maximum of 45 "Yankee" type nuclear submarines. (The Yankee is the Russian counterpart of the Polaris.) Furthermore, the U.S.S.R. may replace 210 of their older (SS-7 and SS-8) land-based missiles with submarine-based ones. This puts an absolute ceiling for U.S.S.R. missile-carrying submarines at 62.

Clearly the most significant agreement from the viewpoint of stemming the arms race is the one regulating the future of A.B.M. installations in the two countries. The A.B.M. systems authorized by the treaty do not have any immediate strategic significance. The system around Moscow certainly cannot prevent the destruction of that city in the event of a massive nuclear attack. In addition, all the other cities of the Soviet Union remain unprotected, a fact that guarantees the deterrent value of the U.S. offensive missile force and, even more significantly, obviates the necessity to arm U.S. missiles with M.I.R.V.s. Such weapons were introduced in an apparent effort to overcome Russia's A.B.M. by saturating its capabilities with a large number of incoming warheads. But in the absence of a Russian A.B.M. the need to install M.I.R.V.s in order to maintain a credible deterrence was also absent. Enough warheads would remain unhindered by A.B.M.s to destroy the cities the A.B.M.s protected. In turn, the Washington A.B.M. system will probably never be built because it has no pragmatic use and also because it may prove to be extremely unpopular.

The A.B.M. systems authorized to protect missile silo fields have equally limited utility. It has been already pointed out that the presence of nontargetable submarine-based missiles makes a first-strike attempt against an opponent's land-based missile force an unnecessary folly: why would the Russians attempt to destroy 1,000 Minuteman missiles when there are 5,000 submarine-based warheads aimed against their unprotected production centers? In the era of the nuclear-carrying submarine, the land-based missile has very little strategic significance; no political or military leader will provoke destruction of his country in an effort to destroy it and any measures to protect a land-based force appear superfluous.

A zero-level A.B.M. would have been preferable. The only conceivable benefit this country or the Soviet Union can derive from the presently authorized system is the opportunity for continuing research in advanced radars, high acceleration missiles, and complex digital computer hardware and software.

Nonetheless, the limiting of A.B.M. to the authorized levels of technological sophistication and number of launchers is a very important step towards restoring deterrence as a preferred strategic posture and eliminating the strategic instability that could propel the accelerating arms race indefinitely. In turn the crisis instability is also dampened since each nation can wait out a nuclear attack once again, without fear of political loss.

The Interim Agreement on offensive weapons is a consequence of the abating of the strategic and crisis instabilities achieved by the A.B.M. partial ban. In the absence of an A.B.M. there is no reason to increase the number or yield of existing weapons since both countries already possess an enormous over-

By the beginning of 1970 it was clear that—barring negotiated control—the arms race spiral and the saturation effect facing us were going to become an unmanageable reality. . . .

kill. The Soviet Union, the United States, and the People's Republic of China each have about two hundred cities with populations over 200,000. Since the former two countries already have several thousand warheads on their strategic offensive missiles (not to mention nuclear bombs on fixed-wing aircraft and nuclear tactical missiles), any addition would merely exacerbate the saturation effect.

The Trade-offs: Fair

The details of the agreement indicate that the United States is willing to allow the Soviet Union the latitude to build additional nuclear missile-carrying submarines in exchange for an upper ceiling of 300 on the giant SS-9 missiles. In turn the Soviet Union is willing to allow the United States to continue arming with M.I.R.V.s its Polaris-based and Minuteman missiles in exchange for the right to develop their own M.I.R.V.s. The object lesson is that agreements limiting weapons are possible only in instances of technological parity. Agreement to limit the number of land-based missiles was possible only when the Soviet Union reached numerical parity in this weapons system with the United States. It is doubtful whether the Soviet Union will ever agree to limit M.I.R.V.s before they have developed their own. The example of the French and the Chinese, who refuse to abide by the Test Ban Treaty until they reach parity in the development of their nuclear weapons with the United States and Russia, is quite eloquent. Therefore the "bargaining chip" argument—"let us build more weapons so that we can have something to bargain away"—is fallacious in the case of the United States because this country is technologically more advanced than the Soviet Union. Unless this country stops and allows the Russians to catch up, nothing will be bargained away and the arms race will continue in those sectors not covered by the agreements reached in S.A.L.T. I.

The arms race has not been stopped. The natural desire of the military to develop as many new weapons systems as possible before future negotiated agreements eliminate the opportunities for their deployment, will, if anything, accelerate the qualitative aspects of the race. The spectre of the intense underground testing that followed the Nuclear Test Ban Treaty in 1963 is not an encouraging precedent to reflect upon S.A.L.T. I left too much to the wisdom and the good will of the two parties to expect that it will stem the arms race and the concomitant escalation of the defense expenditures. Yet S.A.L.T. I has arrested—although not eliminated—the most destabilizing and dangerous components of the race. In that respect it must be a most welcomed development.

What S.A.L.T. II Must Do

Probably the most ominous omission of the S.A.L.T. agreements is the absence of any understanding to limit or stop the intensive development of anti-submarine warfare systems aimed at detecting, localizing, and destroying the missile-carrying submarines of both countries. It must be quite clear by now that the sea-based deterrent is the only nontargetable strategic offensive weapon and therefore the cornerstone of strategic stability. To threaten this component of deterrence, or even to create doubt in the minds of strategic planners as to its invulnerability, is to re-enter a phase of instability and fear, as will be shown in the next article.

Independently of the inclusion of any specific weapons system in the Moscow agreements, the successful conclusion of the first round of S.A.L.T. talks establishes two very important principles. First, that both the Soviet Union and the United States seek to ensure their national security not by means of an absolute superiority in nuclear weapons, a superiority without political meaning, nor through a complete divestment of their nuclear arsenals, but by the establishment of *strategic stability*, a condition characterized by a mutually-held posture of deterrence and a curbing of the arms race. Secondly, the Moscow agreements have introduced disarmament, and negotiated limitations of arms, as measures beneficial to one's national security. Never before in the history of the human race was a decrease in weapons perceived as contributing to the security of a country. But that is part of the paradox that envelops nuclear weapons. It is encouraging that this paradox was perceived, understood, and utilized for mutual benefit.

Next Month

The second article of this series on the implications of S.A.L.T. will follow in the December issue. Its subject is the one area of the arms race not dampened by the Moscow agreement, one that can throw us back into strategic instability: "Underwater Acoustical Arrays: the New A.B.M.?"

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Towards a New Policy for Technology: The Outlines Emerge

In his recent *Technology Review* articles (see "Technology in the United States," June, 1972, pp. 10-21 and July, 1972, pp. 32-42), J. Herbert Hollomon concluded that "the U.S. must re-examine and revise national policies related to technology and its use in society."

The fact is that such a revision has been underway in Washington for the past several years. Federal policy for science and technology underwent particularly intense examination during late 1971, and the results of that examination are reflected in President Nixon's first message to Congress on science and technology, delivered last March.

One long-time student of science and public policy—Dael Wolfle, writing in *Science* (July 7, 1972, p. 13)—suggests that the proposals put forth by Nixon in his March message "deserve searching debate, for, if they are adopted, the current period will be remembered as the time of the most significant turning point in national science policy since the late 1940s."

This article (based on a series of interviews with key participants in the technology policy-making process) traces the origins, substance, and implications of the President's proposals, and of policies and programs introduced so far; in this way, hopefully, providing one basis for such debate. At the same time, it is possible to discern, for comparison, the Democratic posture—not yet spelled out in such detail, but showing obvious similarities at least on the surface.

There are two themes underlying the elevation of technology policy to a matter of Presidential concern. One is the belief that federal research and development efforts should be made more relevant to the domestic problems facing the nation, and that the civilian agencies of the government should thus bear a substantially larger share of the federal research and development budget. The notion of applying our technological capabilities, especially those resulting from federal investments in space and defense programs, to domestic undertakings is not new. Such "conversion" has been discussed ever since the mid-1960s, when the decline in aerospace spending and in military research and development produced a surplus of highly trained manpower; policy-makers started looking for new ways to use the skills of these scientists and engineers (and, incidentally, to keep them employed). A shift in overall national priorities towards emphasis on domestic issues has now provided a political context for this conversion issue; but until last year this question did not generate sufficient pressure to force the government into seriously considering a significant program of civil technological applications. One aspect of the conversion issue which does have strong political overtones is the currently-depressed job market for scientists and engineers; the desire to create employment opportunities related to new civilian research and development projects prior to this year's election was influential in initiating last year's review of technology programs.

Another politically potent stimulus leading to last year's review of research and development policy was the unsatisfactory condition of the nation's economy and the consequent search for remedies, both short- and long-term. Studying the economic crisis, top government officials became convinced that there was a definite but not clearly understood link between investment in research and development and increases in productivity, success in international economic competition, and new employment opportunities. They also became convinced that the nation as a whole was underinvesting in industrial research and development, and that it was necessary to devise and implement incentives to increase such investment to a level that would return the economy to a healthy state and keep it there.

New Technology Opportunities?

In July, 1971, the White House Domestic Council began an effort to identify "new technological opportunities" (N.T.O.) that were both related to national needs and at the same time would contribute to stimulating the economy. This review was perhaps the most intensive examination of the substance of, and rationale for, federal involvement in supporting non-defense research and development ever undertaken. Significant changes analyzed or suggested during the course of the study included: the initiation of

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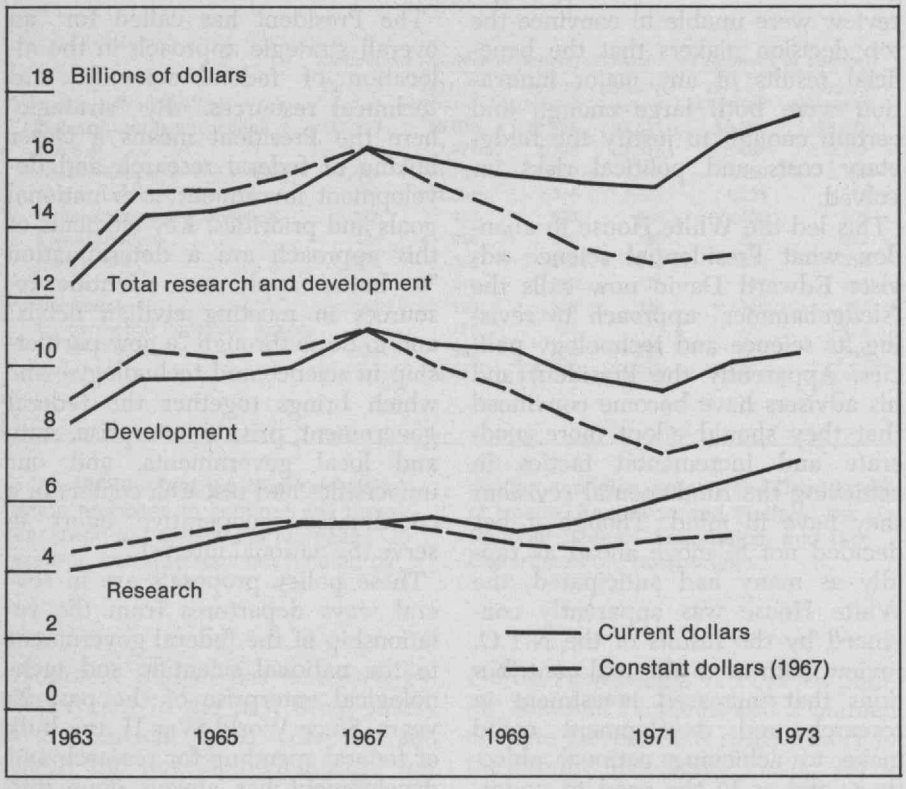
Science and technology are neither isolated from the mainstream of national issues, nor do they provide solutions to all the nation's problems. "Rather, research and development investments are coming to be seen as one among the basic elements to be considered in formulating public policy."



Federal research and development obligations appear to be reversing the downward trend of the years 1967-1970. This was the picture obtained by a survey in mid-fiscal-1972—figures for 1972 and 1973 are estimates—shortly after the annual budget for fiscal 1973 had been forwarded to Congress. (*Federal Funds for Research, Development and Other Scientific Activities*, Vol. XXI, 1972)

large-scale demonstration projects involving several federal agencies; the revision of the federal policy-making structure for science and technology; across-the-board tax credits to stimulate private investment in research and development (or some other form of government action to the same end); revisions in federal anti-trust and patent laws; and other substantial revisions of the status quo in technology policy.

The White House initiated the review of technological opportunities with the overly optimistic hope that such an analysis could (in the words of a Presidential message to Congress of September, 1971) "find the means to insure that . . . the remarkable technology that took . . . Americans to the moon can also be applied to reaching our goals here on earth." Those in charge of the N.T.O. study hoped to identify a few "domestic Apollo programs" with which Mr. Nixon could dramatize a new federal policy for technology.

Instead, the review demonstrated that the context for stimulating technological innovation in the private sector is very different from that of the defense or space sectors, and that there are economic, political, legal, and institutional constraints related to civilian applications of technology which pose significant and largely unanalyzed obstacles to the President's often-repeated aim of "harnessing the wonders of science to the service of man." Indeed, President Nixon has now said as much, in his 1972 State of the Union Address: "much more needs to be known about stimulating and applying research and development."

The N.T.O. review's attempts to find *new* areas for federal research and development spending were thus in a sense unsuccessful, though certainly not from a lack of effort. During the course of the study, each of the 15 federal agencies involved in civilian research and development was asked to suggest technological undertakings related to either domestic opportunities or foreign trade. The responses were analyzed by a series of Executive Office task forces organized according to fields of action—transportation, natural resources, law enforcement, etc. Shortly after the N.T.O. review began last summer, William Magruder, former head of the S.S.T. program, was appointed as a special consultant to the President and named as "program manager" with overall responsibility for the exercise. Magruder broadened the search for new projects by appealing to the private sector. He asked a large number of firms and trade associations to submit their ideas on technological initiatives and the means to finance them. (Apparently the short-term results of this solicitation were not very great, however, and most of the ideas seriously considered by the N.T.O. study group originated from within federal agencies.)

After internal review, each N.T.O. task force met with a blue-ribbon advisory panel to receive comments

on the alternative projects under consideration. Finally, Magruder brought in individuals from N.A.S.A. with experience in the management of aerospace programs to help him put together a final report, which contained organization, schedule, and cost information for each project proposal. During the whole N.T.O. effort, staff members from the Office of Science and Technology, the Council of Economic Advisers, and the Office of Management and Budget worked closely with Magruder.

At its most extensive, the list of possible technological initiatives under consideration would have involved the addition of $1.49 billion to this year's budget and five-year costs of approximately $11 billion; in a sense, however, these numbers have little meaning, since no one anticipated approval of all projects examined. Among the major projects proposed were the development of new nuclear power systems for commercial ships, development of offshore ports for deep-draft tankers, an acceleration of the A.E.C.'s program to win natural gas using nuclear explosions, the full development of high-speed ground transportation in the Northeast Corridor, and a campaign against kidney diseases.

As White House advisers John Erlichman, Peter Flanigan, George Shultz, and Peter Peterson reviewed Magruder's proposals during December, it became clear that each of them was still beset with complex questions—of technological ripeness, environmental impact, institutional capability, economic soundness and political feasibility—which the N.T.O. review had not had enough time to analyze satisfactorily. Lacking such analyses, Magruder and others involved in the review were unable to convince the top decision makers that the beneficial results of any major innovation were both large enough and certain enough to justify the budgetary costs and political risks involved.

This led the White House to abandon what Presidential science adviser Edward David now calls the "sledgehammer" approach to revising its science and technology policies. Apparently the President and his advisers have become convinced that they should adopt more moderate and incremental tactics in achieving the fundamental revisions they have in mind. Though it has decided not to move ahead as rapidly as many had anticipated, the White House was apparently convinced by the results of the N.T.O. review both as to the real contributions that increased investment in research and development could make to achieving national objectives, and as to the need to undertake further studies of the best ways of ensuring that such investments are made wisely.

The New Policy Outlined: Help for the Private Sector

Even though specific policy innovations and major new programs have not yet appeared, there is little doubt that a major change in federal policy for science and technology is being proposed, the key element of which is a more intimate relationship between public and private research and development efforts in non-defense fields. The basic concepts of this new policy have been articulated by the President in his March 16 message to Congress on science and technology, and in several other recent White House pronouncements.

The President has called for "an overall strategic approach in the allocation of federal scientific and technical resources." By "strategic" here the President means a closer linking of federal research and development investment with national goals and priorities. Key elements of this approach are a determination "to better apply our scientific resources in meeting civilian needs" and to do so through "a new partnership in science and technology—one which brings together the federal government, private enterprise, state and local governments, and our universities and research centers in a coordinated, cooperative effort to serve the national interest."

These policy proposals are in several ways departures from the relationship of the federal government to the national scientific and technological enterprise of the past 25 years. Since World War II, the bulk of federal spending for research and development has always gone into the defense, space, atomic energy, and health research fields. Hollomon notes that the United States today invests in "a smaller fraction of publicly supported research and development for economic purposes . . . than any other industrial nation." Now the federal government is proposing to take the lead in stimulating the process of technological innovation in a wide range of industrial activities where the private sector has traditionally played that lead role—such areas as non-nuclear energy production, ground transportation and housing.

In addition, there is an intention to accelerate the growth in the research and development budgets of those federal agencies that deal with domestic issues. Although the civilian section of the research and de-

The new technology policy calls for federal involvement in stimulating the development of goods and services produced by private industry and sold for profit on the market; but how to do this is far from clear.

Department or agency	Obligations (millions of dollars) 1970-71 actual	1971-72 estimated	1972-73 estimated	Expenditures (millions of dollars) 1970-71 actual	1971-72 estimated	1972-73 estimated
Defense—military functions	$7,423	$8,013	$8,756	$7,541	$8,031	$8,177
N.A.S.A.	3,284	3,327	3,302	3,337	3,137	3,131
Health, Education and Welfare	1,466	1,769	2,012	1,288	1,450	1,708
Atomic Energy Commission	1,303	1,308	1,375	1,303	1,308	1,375
National Science Foundation	337	453	525	335	409	455
Transportation	220	296	380	198	233	282
Agriculture	318	356	370	315	349	359
Interior	185	216	250	175	212	238
Commerce	143	169	229	114	146	192
Environmental Protection Agency	137	176	186	101	157	174
All other agencies	328	366	436	298	347	389
Total	$15,143	$16,447	$17,819	$15,005	$15,779	$16,480

In the 1973 budget the Nixon administration proposes to continue the three-year trend of "substantial increases" in research and development funding by civilian agencies, notably the Department of Health, Education and Welfare, the National Science Foundation, and the Department of Transportation.

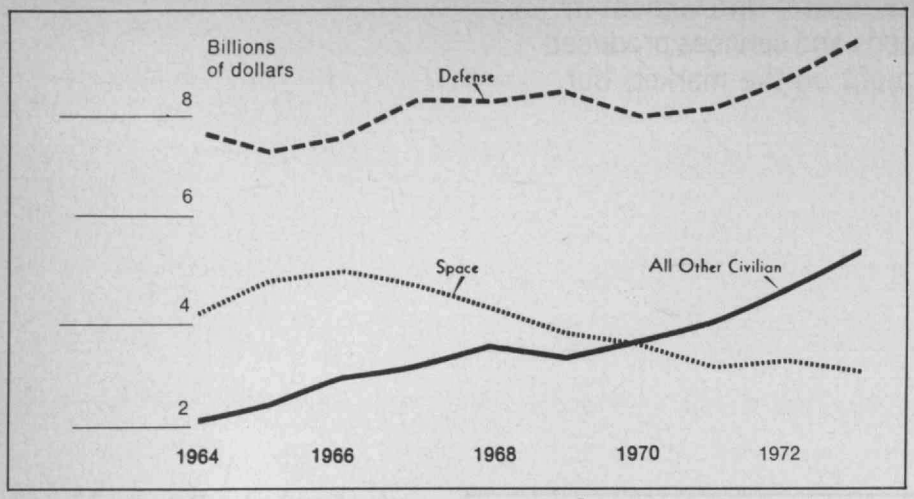
velopment budget has increased by 65 per cent in the past three years, in the current fiscal year the research and development budget for civilian agencies is still only 25 per cent of total federal research and development spending.

Washington also hopes to stimulate state and local governments to utilize the technological resources existing in federal laboratories, in universities, and in high-technology industrial firms. (In fiscal 1968, state and local governments spent only one penny on research and development for each dollar similarly spent by the federal government.) There has been a recent increase in activity aimed at developing at the State and local levels both the desire and the capability to relate science and technology to their concerns. Partnership with the federal government in such an undertaking is the theme of a Federal Council for Science and Technology report *Public Technology: A Tool for Solving National Problems* and a Council of State Government study *Power to the States: Mobilizing Public Technology*.

Potentially the most important and controversial aspect of the new technology policy is the call for federal involvement in stimulating research and development related to goods and services produced by private industry, and sold for profit in the market. The belief that government involvement is required stems from a conviction that the United States as a nation is underinvesting in research and development, particularly in that aimed at increased productivity and economic growth. Economists who support such involvement, including the Council of Economic Advisers (C.E.A.), argue that market mechanisms, if left to operate by themselves, will continue to result in such underinvestment. This is so, the C.E.A. argued in this year's Economic Report, because "although an investment in research and development may produce benefits exceeding its costs from the viewpoint of society as a whole, a firm considering the investment may not be able to translate enough of these benefits into profits on its own products to justify the investment." The conclusion that has been drawn from this line of reasoning is, as the President indicated last March, that "it is appropriate for the federal government to encourage private research and development to the extent that the market mechanism is not effective in bringing needed innovations into use."

In his August 14, 1971, message announcing economic controls, President Nixon directed the Treasury Department to develop "new tax proposals for stimulating research and development" for presentation to Congress this year; later, after such proposals had been studied as part of the N.T.O. effort, the White House decided not to adopt them or any other across-the-board technique for research and development stimulus. Claude Barfield, writing in *National Journal* (6 May, 1972, p. 763), quotes science adviser David as commenting that supporters of such proposals as a 7-per-cent tax credit for research and development investment were not able to show that they "would, in fact, accomplish the desired end. . . . Their proposals were made without adequate evidence of cost-effectiveness, economic tradeoffs, and the reallocation of private and public resources."

In addition to tax policy, other methods of stimulating private investment in research and development examined during the N.T.O. review included aspects of patent, procurement, regulatory, and anti-



"Substantial increases" in existing programs and "new efforts to focus scientific and technological capabilities on specific problems of concern to the nation" are included in President Nixon's 1973 budget; the Office and Management and Budget notes that the 1973 estimate for nondefense, nonspace research and development represents a 65 per cent increase over the 1969 figure. (See also the table on page 39.)

trust policies. The administration has made some policy modifications intended to encourage the operation of small high-technology firms, and has indicated that it will interpret antitrust laws in such a way as to allow industries to undertake joint research and development efforts if those efforts improve the allocation of the nation's resources. But more basic changes in the economic policies that provide the context for industrial research and development will likely await the results of further analyses of the implications of such changes.

Federal intervention in private-sector research and development, either through direct subsidies or through more indirect forms of stimulation, is not without its critics. Eads and Nelson argue that a "conscious national decision to achieve very high rates of technical progress in a particular field is tantamount to a decision that traditional decentralized modes of research and development organization, decision-making, and risk-taking be superseded by a much more concentrated and centralized structure." The result of such centralization, they suggest, is likely to be costly and highly inefficient research and development programs. Eads and Nelson also believe that "government commitments to particular technologies and products pose an unusually difficult problem of public control."

If implemented, this new technology policy will represent a very significant departure. But, as noted above, last year's N.T.O. review demonstrated that the government does not now know either how to go about stimulating technological innovation in the private sector or how to match the research and development programs and capabilities of federal agencies to national needs and opportunities in enough detail to move ahead rapidly. The *Economic Report of the President* notes that "while it is clear that Federal involvement is essential to prevent underinvestment in research and development, the optimal amount of this activity is much less clear. The proper allocation of research and development among alternative activities presents a further problem."

Other issues still to be resolved include the choice of appropriate mechanisms for federal stimulation of the private research and development process, and possible reorganization of the management structure for federal research and development. If there are to be fundamental changes in federal policy for science and technology, important questions of what to do, who should do it, who should pay for it, and how should it be managed must still be answered.

Programs For Acquiring Confidence

In an attempt to develop answers to some of these questions, two new programs were included in this year's budget. One, called the "Experimental Research and Development Incentives Program," will be conducted jointly by the National Science Foundation and by the National Bureau of Standards. The other is called the "National Research and Development Assessment Program"; it too will be managed by N.S.F.

In his science and technology message, the President indicated that the purpose of the incentives program would be "to determine effective ways of stimulating non-federal investment in research and development" by a series of experiments "to test a variety of partnership arrangements among the various levels of government, private firms and universities." The need for such experiments derives directly from the lack of information on the consequences of various forms of research and development incentives which was uncovered by the N.T.O. review.

The President suggested that the experimental technology incentives program would test new arrangements for—among other things—cost sharing, patent licensing, and research support. The N.B.S. portion of the experimental incentives program will aim particularly at evaluating different ways of conducting joint research and development ventures between government and industry; the N.S.F. part of the program will be focused on relationships among universities and one or more of the following: federal, state, and local governments; research institutes; government laboratories; and to some degree, private industry. Both sides of the incentives program will attempt to create controlled circumstances in which prototype operations can be launched and can provide some of the experience needed to evaluate the effectiveness of any one incentive, or a combination of incentives, for stimulating the research and development process and for assuring that the results of that process are effectively utilized.

The program of national research and development assessment will aim at providing a fuller understanding of how science and technology contribute to national goals and objectives. The hope is that the program will lead to a capability for the analysis in depth of alternative federal actions that might in-

Hitherto, the White House has had no way of systematically relating federal agency research and development programs to national goals.

fluence the processes of research and technological innovation. Areas which the assessment program intends to investigate include: overall research and development patterns; the incentive structures and decision points that have produced existing means for the support, performance, and utilization of research and development, both in the United States and in other countries; and the implications of various policy options for future research and development activity.

Last year, when confronted with the need to evaluate alternative means of stimulating research and development, and applying its results, the White House found that its technical and economic advisers were unable to say with any confidence what the results of a particular policy choice were likely to be. It may take several years to learn whether these two modestly funded (approximately $30 to $35 million for fiscal 1973) but broadly conceived programs of research and experimentation will be able to generate enough credible information to increase the confidence level of decision-makers in future considerations related to technology policy.

How to Organize the Action?

Because no large new federal programs were approved as a result of the N.T.O. review, the White House has not yet had to answer a question which arose early in the study and persisted throughout—how would such new civilian research and development programs be managed? One finding of the study was that there was an almost total lack of capabilities for systems management and program definition, outside of the defense, space, and atomic energy agencies.

In order to make it possible, in the face of such a lack, to undertake large-scale technological efforts in the civil sector, the concept was examined of joint ventures between a cabinet-level civilian agency and one of the high-technology agencies—N.A.S.A., N.B.S., or A.E.C. Under such an arrangement, a civilian department might have the policy leadership and overall administrative responsibilities for a particular project, while a technology agency would be responsible for technical management and procurement activities. This joint venture approach was reflected in this year's budget, which contained proposals for several joint Department of Transportation-N.A.S.A. efforts on air and ground transportation. If the government does decide in the near future to go ahead with any major new research and development program in the civil sector, the joint venture model is the likely choice for organizing that program.

The very existence of the N.T.O. review emphasized the previous lack of any systematic means for the White House to relate, on a continuing basis, existing agency research and development programs and emerging technological potentials to national goals. This was particularly evident as regards the kind of thoroughgoing analysis which would examine economic, political, legal, and other issues related to domestic research and development undertakings. The eventual development in the Executive Office of the President of a new institutional capability to make such overall assessments, and to translate them into coherent federal research and development programs involving several agencies, seems almost inevitable; although the precise nature of the organization that would perform this overview function is still unclear.

This ability to relate specific projects to national goals and priorities is a key element in the Administration's "strategic" approach to research and development decisions. Presidential science adviser Edward David talks of the need for an "activist" philosophy and a "more managerial viewpoint" with respect to research and development within the Executive Office, and the corresponding need to plan, coordinate, and evaluate ongoing and proposed federal research and development activities at that level—the old notion of a Department of Science and Technology to perform many of these functions does not match the tendency of the Nixon administration to centralize policy-making activities within the institutional White House. Thus, it is most likely either that the existing Office of Science and Technology will be reorganized and assigned this policy overview function, or that a new White House entity, perhaps on the model of the Council of Economic Advisers, will be created to undertake it.

Other Proposals

The technology policy proposals which have been put forth by the Nixon administration have been made the central theme of this article because they have been spelled out in some detail, because they are responses to issues which were being discussed even before Nixon took office, and also because they are in some ways similar to the less detailed proposals of Democratic presidential contender George McGovern. (Given the overall context of McGovern's campaign pro-

posals, these apparent similarities may mask very basic differences in underlying philosophy and specific emphases.)

The issue of conversion from defense-oriented to civilian-oriented federal research and development has been of particular interest to McGovern for almost ten years, and he has proposed several pieces of legislation related to it. A detailed campaign paper on further conversion proposals was in the works as this article was being written. McGovern's most recent proposals for research and development policy (as quoted in the *Congressional Record*, 20 Apr., 1972, pp. SS. 6499-6500) include:

- ☐ "Greatly expanded funding for research and development across the whole range of public concerns."
- ☐ "Effective methods of stimulating research in the private sector . . .", including "research with purely commercial application."
- ☐ A "search for ways to stimulate and encourage smaller technical enterprise."

One point in which McGovern's proposals do differ greatly from those of the Nixon administration is the Democratic nominee's pledge of an immediate $10 billion economic stimulus, which would include technology-intensive contracts for new and rehabilitated housing, public transportation systems, and environmental protection.

In mid-August the Senate approved major initiatives related both to the conversion process and to the use of science and technology for domestic purposes. These initiatives are contained in a bill, S. 32, which was developed by Senator Edward Kennedy, who has become the leading Democratic spokesman on science and technology issues; Senator McGovern is a strong supporter of Kennedy's proposals. This bill was originally called the "Conversion Research, Education, and Assistance Act of 1971," but now has been considerably broadened in scope and renamed the "National Science Policy and Priorities Act of 1972."

The bill would authorize over $800 million to be spent over three years for the development and testing of new "civil science" systems to provide improved public services in such areas as health care, public safety and housing. It also provides $200 million to aid the process of conversion to a federal research and development system dominated by civilian programs. To manage most of the new research and development programs it authorizes, the Kennedy bill would establish a Civil Science Systems Administration within the National Science Foundation. S. 32 would put Congress on record as declaring as matters of national policy that:

- ☐ Federal funding for research and development must increase at a rate which will assure "an annual qualitative growth in the gross national product needed to sustain a full employment economy."
- ☐ Scientists and engineers must have continuing employment opportunities.
- ☐ Federal funds for civilian research and development must be increased so that they at least achieve parity with the corresponding military figure.
- ☐ Federal programs for civilian research and development must be focused on meeting national needs in priority areas.

Although the Senate approved S. 32 by a 70 to 8 vote, it is unlikely that the House will complete action on the proposal during the current session. This will leave matters in the hands of the next Congress.

A Perception of Need

Although partisan political considerations have had some influence on the reshaping of national policy for science and technology, the basic factors underlying such changes are related to shifts which have taken place during the past half-decade or so in the economic, social, and political environments of the nation. There has been a growing consensus that the links between science, technology, and national goals (such as power and economic growth), strategy to cement those links, and the institutions to implement that strategy, are all in the need of overhaul. Robert Gilpin caught the essence of this feeling (*Science*, 31 July 1971, p. 446) when he referred to the need for the United States to develop a "more explicit technological strategy designed to increase the social return of its immense investment in science and technology and to minimize its negative returns"; Hollomon's recent articles are a comprehensive review of the considerations leading to such a conclusion. The developments described above reflect the perception of a need for change, and are potentially major steps in the creation of a technology policy which matches the mood and needs of the country.

Five years ago, when the Paris-based Organization for Economic Cooperation and Development reviewed U.S. science and technology policy, the conclusion was that the technological enterprize "is indissolubly linked to the goals of American society, which is trying to build its future on the progress of science and technology." In a sense, this was not an accurate description of post-World War II public policy for technology, which was somewhat narrowly aimed at objectives of international power and prestige. But it is a valid assessment of the basic philosophy behind the current policy revisions.

Top decision-makers are coming to see science and technology policy neither as isolated from the mainstream of national issues, nor as a means of solving all the nation's problems. Rather, research and development investments are coming to be seen as one among the many basic elements to be considered in formulating public policies. The beginning of the integration of technology policy with domestic policy is perhaps the most significant result of the activities in Washington during the past year.

To date, there have been many declarations of intent related to changes in technology policy, but little in the way of funds for specific new projects or in the way of actual policy modifications with concrete impacts. Whether, and how fast, such developments occur will provide the evidence for evaluating the ability of government to tap this nation's technological potentials so as to improve the quality of its citizens' lives.

Related Readings

J. Herbert Hollomon, "Technology in the United States," *Technology Review*, June, 1972, pp. 10-21, and July/August, 1972, pp. 32-42.

Claude Barfield, "White House Views Intense Technology Hunt As Useful Exercise," *National Journal*, May 6, 1972, p. 763 (see also *National Journal*, May 13, 1972, for details of the N.T.O. study and its results).

George Eads and Richard R. Nelson, "Government Support of Advanced Civilian Technology," *Public Policy*, Summer, 1971, pp. 405-427.

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65 Cars in Search of the Future

A report on Urban Vehicle Design Contest: How engineering students from 57 universities would resolve the basic antagonism of automobile and city

The speedometer needle of the white Buick wagon whipped to the right, finally quivering between eighty and ninety. The car fled from a dangerously tight, badly banked turn on route 23, one of the first limited-access highways built in Michigan, and probably one of the worst in the country. Worth $7,200, of which about $2,000 represented the cost of such options as electrically-powered windows and door locks, six-position electrically-powered front seats, and cruise-control, the wagon had been provided by General Motors to the members of the Urban Vehicle Design Competition (U.V.D.C.) coordinating committee; it was now, at 6 a.m. on Monday, August 7, 1972, carrying several members of that committee north toward the General Motors Proving Ground near Milford, Mich. Also converging with great rapidity on the Proving Ground at about that time—many in rented trucks—were more than 60 teams from colleges and universities throughout the continent. With them they brought vehicles designed to be safe, low polluting, well suited to an urban environment. During the coming week, the cars would undergo tests for exhaust emissions, energy efficiency, resistance to damage in five-m.p.h. crashes, handling, consumer cost, safety, noise, acceleration, and braking ability.

For many of the competing teams, the major point of their work would be to demonstrate the feasibility of a radical idea—such as the hydrogen-powered vehicle. But every team understood as matters beyond debate the basic antagonism of the automobile and the city and the coming scarcity of virtually all types of fossil fuel. Meanwhile, though the automobile industry was quietly experimenting with long-range possibilities for transportation, it sometimes seemed that in Motor City's world view, what was truly frightening was the attempt by the government to induce, or finally compel, the consumer to purchase at greater cost a vehicle that, due to emissions control devices, would not start or accelerate with the same virility.

Regardless of whether or not the entries in the U.V.D.C. were technological marvels, they suggested a future requiring more drastic change than Detroit perhaps wanted to understand. Many of the student teams moving toward Milford had grown up under the influence of the car and the highway; their joyous velocity toward the Proving Ground made a curious contrast with the nature of the competition and of the future they were predicting. Though many entrants did not think of it as they drove toward Milford, they were working to undermine the symbiosis of the automobile and the American psyche.

The Decline of the Gods

In 1968, M.I.T. was challenged by Cal Tech to a cross-country automobile race in the spirit of the competitions that took place at the dawn of the automotive age. For this race, the vehicles were to be electrically powered; though electricity generating plants do indeed pollute, transferring and centralizing the source of pollution—from automobiles tracing random paths through an urban area to a power plant far outside the city—might indeed have beneficial effects on the air.

The "Great Electric Car Race," which M.I.T. lost, received a gratifying amount of publicity (*see* Technology Review *for October/November, 1968, pp. 83-85*). The Clean Air Car Race (C.A.C.R.) organizing committee was formed shortly thereafter from students at those two institutions, and two years later 40 vehicles entered by students from as many universities competed in a race from M.I.T. to Cal Tech, trying to pollute as little as possible en route (*see* Technology Review *for January, 1971, pp. 20–29*).

It was announced following the C.A.C.R. that many of the entries had met or bettered the then-proposed standards for automotive emissions in the three categories of hydrocarbons, carbon monoxide, and nitrogen oxides. "Because certain vehicle entries in the C.A.C.R. had performed extremely well during the emissions testing," C.A.C.R.'s Summary Report stated in a section titled "Political Impact," "Congressional advocates of cleaner air were quick to seize on the test results and interpret them as factual proof of an existing solution."

In fact, the C.A.C.R. results on emissions had provided no such proof. In a section titled "*Nota Bene*," the Summary Report admits that "because the C.A.C.R. test procedure . . . did not correspond on a number of points to what had been specified in . . . the Federal Register, there is some question as to whether these . . . vehicles have actually bettered the proposed Federal standards. . .".

In the C.A.C.R. testing, concentrations of pollutants in samples taken from tailpipes were "weighted by standard factors," "corrected for differences in fuel composition and air-fuel ratio," and multiplied by "the calculated vehicle exhaust volume flow rate," all of which reduces to the use of fudge factors to extrapolate from the sample to the total polluting the car has done.

Before the 1972-model-year, emissions testing customarily proceeded much as it did in the C.A.C.R.: an exhaust sample taken continuously from a car's tailpipe as it was driven over a specified driving cycle of velocity versus time would be analyzed to determine the concentrations, in parts per million, of pollutants; and these results would then be multiplied by fudge factors in an attempt to extrapolate from the sample's concentrations to the total polluting the car would do if driven a mile.

For model-years 1972 to 1974, federally established test procedures would require a more sophisticated methodology, called Constant Volume Sampling (C.V.S.). The exhaust produced by a car being driven over the specified cycle would be mixed with sufficient neutral air so that the total amount of gas produced by a car driven over the entire cycle would be a constant, identical for any car. Throughout the test, a portion of this gas flow would be diverted into a bag. Then the relationship of the volume of this sample to the volume of the exhaust produced in a mile of driving would be known with certainty. Emissions would be expressed in grams per mile, completely and justifiably superceding parts per million.

For model-year 1975, the driving cycle is to be made into a more complicated series of accelerations, decelerations, and stops—to better reflect, according to the federal standard-makers, the realities of driving; and the exhaust will be channeled into a series of three bags to assure that results better reflect the effects of variations in the temperature of the power plant and control devices.

The emission of hydrocarbons decreases as an engine is warmed up, and catalytic converters more effectively transform carbon monoxide to carbon dioxide as the temperature of the catalyst is increased. Thus the new federal test procedure prescribes that testing should begin with power plants cold, after a 12-hour "cold-soak" period during which the car simply comes to agreement with an ambient temperature required to be between 60° and 86° F.

Each test is more demanding than its predecessor; in fact, the C.A.C.R. testing procedures may have eliminated as much as half of the pollution that would have been shown had the test procedures been those that will be used in 1975 to determine if the industry's automobiles meet the standards some of the C.A.C.R. vehicles had apparently bettered.

No matter. The press had figures which indicated that student-built cars had managed what the automakers insisted could not be done. Senator Gaylord Nelson read the C.A.C.R. emissions results into the Congressional Record, while Congress was considering legislation that would move 1980-level emissions standards up to 1975 and 1976. "The degree to which the Clean Air Car Race was instrumental in the passage of this legislation cannot be determined," the C.A.C.R. Summary Report drily stated, "but the test results certainly were reviewed by automotive experts within government and industry. The C.A.C.R. fostered speculation that a solution in the near future was possible. . . ."

When people involved in C.A.C.R. decided to move onward from the race concept, useful for publicity but of questionable value as a relevant test for the automotive needs of the future, they chose a broader design challenge: vehicles planned specifically for city driving, to be evaluated in an unimpeachable series of tests for the performance of an "urban vehicle."

It was the interest of Ernest Starkman, Vice President in charge of the Environmental Activities Staff at General Motors, that led G.M. to offer U.V.D.C. use of the Proving Ground. Dr. Starkman was Professor of Mechanical Engineering at the University of California (Berkeley) before his appointment at General Motors in April, 1971. He took the job, he says, because the challenge had moved from the regulatory agencies to industry; the useful work was no longer in "establishing targets."

Agreement was reached for testing U.V.D.C. entries at the G.M.P.G. from Monday, August 7, through Thursday, August 10, with retesting as necessary on Friday. The timing was fortunate for G.M., which would have finished testing its own 1973 models to see that they complied with federal standards about a week before the arrival of the U.V.D.C.

Proving Ground

A line of moraines across Michigan marks the end of the ice-age glaciers' progress; behind these hills is an outwash plain. Thus has the land been prepared for the use of the largest corporation in the history of the world: the moraines allow the construction of graded roads, with their percentages marked, and the outwash plain is the site of two recent additions to the General Motors Proving Ground: a circular test track of about 4.5 miles' circumference, banked to allow cars in the fastest lane to cruise at 110 m.p.h. around

The emissions scores of a previous collegiate competition were mistakenly used as evidence that tough automobile anti-pollution standards were justified. It is possible that they helped induce Congress to move up deadlines for the auto industry.

the circle with no need to steer; and, in the interior of that circle, an approximate square of asphalt measuring 67 acres, or, in a more universal unit, 59 football fields. This utterly flat black expanse, elegantly crisscrossed by a network of skid-marks, is the Vehicle Dynamics Test Area, otherwise known as Black Lake, The Lake, or The Pit.

It is to be the headquarters area for the U.V.D.C.

Just off the edge of The Pit is a large trailer; next to that is a large tent in which G.M. will provide hamburgers, hot dogs, coffee, soda, and "very small things with ice cream in them" during the week. Not far from the middle of The Pit, sitting on the plane of asphalt like a set for a Fellini film, is another tent, whose red-and-white-striped canvas has a dingy sort of gaiety. In this tent, a safety panel will inspect and rate the cars for devices and modifications in the safety area; and a consumer-cost panel will estimate the cost of each vehicle, were industry to mass-produce 200,000 of them. At the far end of The Pit, near another, smaller tent, a handling course has been marked out. Though this test relies to some extent on the skill of the driver rather than the excellence of the car, it will favor small cars and innovative suspension systems. One car that will do very well is Western Washington State's entry, whose wheels can turn to nearly a right angle.

Above: Northwestern University's entry undergoes emissions testing on a dynamometer. Displays of miles per hour and a "driving cycle" that is to be followed occupy the attention of the driver. Below: Georgia Tech's "Ramblin' Wreck" just after it has been sent into a barrier at 5 m.p.h. A bolt sheared, causing the bumper to detach; otherwise, there was no damage.

Other tests will be staged on segments of road near The Pit: acceleration, braking, noise, radius of turning circle. "Parkability" will be measured by four means: the ability of the driver to see the ground around the car, the ability of the car to pull out of a parking space (these tests measured by the driver's ability to see cones and to avoid knocking them over, respectively), the force required to turn the wheel of the stationary car, and a subjective judgment made by other competitors. "Driveability" will be judged by a panel making "15 subjective tests on the vehicle." "Space utilization" will be measured by the number of shopping bags that can be placed on the car's floor without crumpling the bags or obstructing vision.

"Energy efficiency" will be judged after the car has been driven 50 miles by a professional driver. It would be an easy measurement could it be expressed in anything as simple as miles per gallon; unfortunately, the test requires a comparison between such fuels as ammonia, propane, liquid natural gas, and hydrogen. To measure the amount of fuel used, the perfect gas law and a measurement of pressure will be invoked for gases, flow meters—or a bathroom scale if the tanks are detachable from the car—for cryogenically stored liquids. And comparing fuel efficiencies will require a chemistry text. The calculation will be of miles per million B.t.u.'s.

Elsewhere on the Proving Ground bumpers will be tested in 5-m.p.h. collisions at Impact Facility No. 2, and pollutants in car exhausts will be measured at the Vehicle Emission Laboratory.

Weighting factors alter the relative importance of the tests: in the competitive scoring of the entries, emissions testing represents 20 per cent of the total; safety 17.5 per cent; consumer cost, energy efficiency, and the 5-m.p.h. crashes, 10 per cent each; and noise 7.5 per cent. All other tests have lower relative value.

Test scores multiplied by weighting factors do not add up to a final score, however. This subtotal is to be multiplied by one overall weighting factor, called the Student Innovation Multiplier, or S.I.M., which varies between zero and 1.5. These S.I.M. points are to be assigned by a jury of team captains, in categories: 0.4 for powerplant, 0.2 for bumpers, 0.4 for safety, 0.1 for emissions controls, and so on. The S.I.M. is to provide a reward for student-designed innovations or modifications in the entries, though modifications must outperform the commercial originals if they are to receive points.

The final score, then, is calculated by scoring individual tests, multiplying by that test's weighting factor, adding, then multiplying the total by the S.I.M. for that entry.

The Iridescent Altar

By 7 a.m. Monday, there is a line of vehicles parked along a line of cones on The Pit: rented trucks, piggybacks, and—next to these familiar-looking vehicles—about 60 entries, many more than the U.V.D.C. organizing committee had hoped would show up. Some are futuristically alien in appearance to production line cars, while others look as if molded from papier-maché, with erector-set machineries visible under their hoods. In many cars, the mechanisms have grown like cancers to engulf much of the passenger compartment. Still other entries look completely normal, their secrets hidden within.

It is raining, though not very hard, and it will rain almost continuously during daylight until Wednesday afternoon. The Pit is flat, but its northeast corner is 16 feet higher than its southwest, and thus rainwater flows, not in streams but in films, from all the surface of The Pit toward the line of entries and support vehicles, and, beyond them, at the side of The Pit, the incline on which the headquarters trailer is located. From under one entry issues an iridescent trail of fluid; four people are clustered at the hood as if their car were an altar, but one of the four is cursing. Many of the cars do not want to start in the rain; others are still being feverishly worked upon.

A two-hour delay in testing has been announced, backing up the actual beginning of the competition to 10 o'clock. But at about 9:30 the excitement of the competition and the unusual nature of the entries begin to reveal themselves. A car pulls out of the line and begins cruising around the asphalt, its engine producing a nagging whine utterly unlike the sound one expects of an automobile. Next to another entry, still being tinkered with, are scattered twelve cases of beer cans, which prove to be sealed empties obtained from the brewery. The cans are used in the car's bumper; each, a team member says, will handle 2,000 inch-pounds in a collision. Other cars are being fueled by cylinders of gas. A car that runs on ammonia leaves an exhaust with a urine scent.

Emissions

G.M.'s Vehicle Emissions Laboratory was opened only last August. Most of its floor space is divided between a "soak area" and a test

The If-these-kids-can-do-it-why-can't-Detroit? line was wrong. But the competition's academic evaluators insisted further that the objectives of industry and the students differed so vastly that comparison was impossible.

area, along one wall of which are partitions, each containing a dynamometer—essentially a pair of rotating cylinders over which the drive wheels of the tested vehicle are placed. These cylinders are weighted to produce a simulation of the energy lost through the wheels during motion along a road.

A wheel somewhat larger than a motorcycle wheel makes contact with the drums of the dynamometer alongside the car's wheel on the driver's side. As this wheel turns, it generates a measurement of miles per hour which animates the pointer of a chart graph that hovers outside the driver's window. On the chart is the federal driving cycle for 1975, which, it is said, bears some resemblance to highway driving, though the curve only once rises above 50 m.p.h. and requires numerous stops. It is the driver's work to see that the pointer follows the black line already on the paper.

A large hose is connected from the tailpipe of the car to a console above which, on a rack like a dry cleaner's, hang six plastic bags, each one with a small tube like an umbilical cord entering at its middle.

Before a car reaches the Laboratory, it is to be driven 25 miles on a test track; it then goes into cold-soak for at least 12 hours. On the dynamometer, it is cold-started and run for the first part of the cycle; the collected vapors comprise the contents of the first bag. A sample is taken of the ambient air: bag two. The next driving segment provides the contents of the third bag, and the fourth is a second background sample. The engine is then shut off, the hood is closed, and finally the car is restarted and driven, filling the fifth bag. The sixth is another background sample.

This test procedure is virtually identical to the federally specified one for the testing of 1975- and 1976-model-year cars to insure that they meet the emissions standards imposed by the 1970 Clean Air Act amendment: a 90 per cent reduction from average 1970 levels of carbon monoxide and hydrocarbons emissions by 1975, and 90 per cent reduction from 1971 by 1976 in nitrogen oxides. Since reductions had been achieved in response to earlier legislation on fumes escaping from the crankcase, G.M. claims that the automobile industry is being compelled to reduce overall pollution by 97 per cent of hydrocarbons and 96 per cent of carbon monoxide compared to the levels in 1960, when cars ran wild in the streets.

Of primary importance in comparing the U.V.D.C. requirements and those on the industry's products: the industry must test cars taken off the production line—not prototypes, or even carefully tuned vehicles—and its products must meet the standards when new and after 50,000 miles. U.V.D.C. entries are obviously not production-line vehicles, and they are tested after only 25 miles of driving.

The University of Detroit team's car was driven on Sunday, and has been in "cold soak" overnight. On Monday, theirs is the first car to be put on a dynamometer.

The car is a Maverick, but its shape is different, for the team has shortened the car by five feet and widened it by one. The power plant, though, is not one they have developed. It is a four-cylinder stratified-charge engine, built by Ford, one of a handful in existence, on loan from the Environmental Protection Agency. The team received the engine and mounted it in their vehicle only two weeks ago.

The pistons in the stratified-charge engine have depressions in their faces. The air-fuel mixture is ignited in this depression at a very rich mixture; as the piston is repulsed by the combustion, it creates a turbulence that then thins the mixture out to a much leaner one than is possible in a conventional engine, where the mixture is necessarily delivered to the combustion chamber at a richness sufficient for ignition. Among the theoretical gains are greater fuel efficiency and lower emissions.

The federal government had been experimenting with the stratified-charge engine when the 1975 standards were promulgated and at that time responded to the anguish in the industry by claiming it as a very promising concept. Since then little had been heard of it, and the expert consensus seemed to be that the engine, though interesting, required excessive maintenance: several engine adjustments were critical to good performance, rendering the idea awkward, even useless, for mass production.

Now, it almost seemed that the engine had been snuck into the competition for testing free of charge by the largest, best-equipped test facility in existence. In fact, a second entry, that of the U.S. Military Academy, also carried a borrowed stratified-charge engine. Though the University of Detroit car would perform well in emissions testing and would win an emissions award for an internal combustion engine running on liquid fuel, the Military Academy car would sink into a detuned coma, roiling in swirling blue fumes.

The University of Detroit Maverick has been driven through the test cycle, and the bags have been taken

off the hanger and carried about 50 feet away, where, only slightly bulging, they have been laid upon the concrete floor, and one—the sample from the second part of the cycle—has been connected to a tube. Behind a window, several G.M. technicians are leaning over a console which, unlike the other handsomely tailored consoles in the control room, is "home-brew"; G.M. has only recently prepared some of its units for 1975 testing procedures. Another technician is explaining the test process.

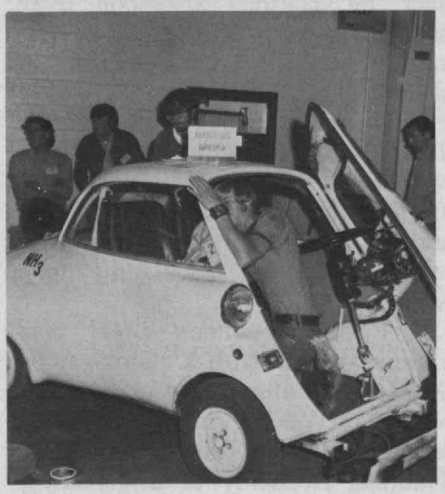
Tests for carbon monoxide and nitrogen oxides are performed by light cells irradiated by infrared light at frequencies in the tested-for substance's absorption spectrum; the test for hydrocarbons is performed by a flame ionization detector. The results will be in grams per mile, a more compelling measurement than parts per million, seemingly of an automobile's excrescence.

"Hey!" the technician shepherding the six bags suddenly exclaims. At his feet, the bag containing the sample from the second part of the driving cycle has swelled to the size of a well-stuffed pillow. He rips off the umbilical cord and after rapping on the glass holds up the bag. The technicians leaning over the analyzers look up, then look back at the console.

After about ten minutes, someone comes out of the control room and says that they would like to do it over.

The Barrier

Impact Facility No. 2 is a large building somewhat like a hangar. Attached to the back of the building is a shed; extending from the shed is an asphalt roadway, down the



A collection of U.V.D.C. entries at the Proving Ground. For convenience, we take the name of the university as synonymous with that of the entry. Top row, left to right: U.C.L.A., the University of Wisconsin, Kansas State on the handling course, and Western Washington State. Middle row: Cleveland Institute of Art and Case Western Reserve (a joint entry), University of Manitoba with M.I.T. in background, Western Ontario being inspected for safety features, and Georgia Tech (one of two entries). Bottom row: Western Ontario and Tufts, both in the repair shop, Buffalo State, and the University of Tennessee.

middle of which runs a shallow track. Guided by this track, a "sled" pulls a car into a massive metal bar held up by two supports, both attached to force-gauges. When the car is within a few feet of the barrier, chains are released. In a fraction of a second, a U.V.D.C. team will be possessors of a car which may or may not have sustained damage in a 5-m.p.h. collision, and they will be able to look at a graph showing force versus time. For a well designed bumper, the curve will show a few oscillations or a flattened, extended peak, proving that the change in the car's momentum was widely distributed in time.

The U.V.D.C. entries are of two sorts: recoverable systems engineered to absorb the force of collisions, or non-recoverable systems meant to vent the force of a collision on some endeavor other than crumpling the car. One type of this second design, subject of much discussion, especially among the press, is the beer-can bumper, in which, usually, four or more beer cans are placed on end in a scissor-like device, and are flattened in a 5-m.p.h. crash.

The barrier test is judged by a panel of three insurance adjusters who inspect the car and estimate repair cost. Scoring is on a linear scale from zero to 250 points, with the full amount going to cars sustaining no damage and nothing to cars sustaining damage with repair cost of $300 or more.

A pinnacle of emotion is attained at the barrier. Proving Ground personnel are here required to move the sled forward and back, a task something like walking a massive and reluctant dog, and then attach chains to the underside of the entrants' cars. After a while, they would begin to notice features of the entries that amused them as they lay on their backs while the rain came down on them. Chuckling, they walk over to the shed, where, a few feet from the barrier, the automobile butchers throw a switch, actuating General Electric Special Purpose Drive SP-200 (from the interior of which one person periodically produced cigars) and an ominous warning bleeper, which sounds every second or two for four or five repetitions and then is silent as the car is pulled toward the barrier. It is at this point that the suddenly horrified teams appreciate for perhaps the first time the rapidity of motion at 5-m.p.h.

Passive Restraint System

Testing was halted at 1 p.m. on Friday, though many teams has not managed to put their cars through all the tests. Having no other choice, the U.V.D.C. coordinating committee assumed that the teams' chances of getting their cars through the entire testing program had been equal. Those cars that did not make it probably were not running at some point in the competition; in fact, on Tuesday afternoon there were 15 entries—almost one quarter of the competition—in a building set aside for car repairs.

Between one o'clock and an awards banquet Friday night, the committee was to calculate the scores and determine the recipients of the various awards. As the banquet began, they would still be calculating total scores.

A Friday afternoon press conference begins with a statement by Professor Phillip Myers of the University of Wisconsin, chairman of an evaluating committee set up by the National Academy of Engineering. The statement praises the U.V.D.C. as great engineering education. "Several innovative ideas" were shown: an energy-absorbing bumper using glass beads as a working fluid, a drunk detector, 90° steering geometry. There were "many interesting combinations of industry-developed components . . . which may or may not have commercial application."

The U.V.D.C., reads the evaluating committee's report, "was not a competition between student engineers and industry engineers to design a vehicle suitable for mass production. Comparing student vehicles with industry designed vehicles is impossible because they have vastly differing objectives and requirements."

Though perhaps the requirements of mass production did not enter into the teams' work, one wonders about the other assertion that the *objectives* of industry and the students differ so "vastly" that comparison is "impossible." The objectives which the U.V.D.C. proposed to its entrants were to "incorporate ecological and social considerations as a basis in the design process" and to construct "a vehicle designed specifically for use in urban areas." What exactly are the "vastly differing objectives of industry? While certainly the "If-these-kids-can-do-it-why-can't-Detroit?" line was wrong —these kids had *not* done it—it seemed that an opposite extreme was attained: the effort was made to indicate that the competition had nothing whatever to say, or even imply, about the shortcomings of the products of American industry.

When, a reporter from a local station wants to know, will the awards be announced?

"8:05," says John Sununu, from the side, straightening up and smiling

Cars powered by electricity were the highest scoring vehicles. One of them would have taken the grand prize, but none could run a required 50-mile course.

faintly. Dr. Sununu, Associate Dean of Engineering at Tufts, was one of the ten founders of Student Competitions on Relevant Engineering, which sponsored the U.V.D.C., and as S.C.O.R.E. Chairman he had helped U.V.D.C. to run the competition through the week.

John Volpe, Secretary of Transportation, makes a short statement: $720 million invested in this state . . . Dr. Sununu is a professor at Tufts, two miles from my home . . . responsible youth . . .".

Questioning begins, little of it concerning the U.V.D.C. Finally, Mr. Volpe is asked about periscopes. Still being looked at, Volpe replies, and continues: "We're not going to ask that every car have a $1,000 device that would save one life a year. I can't tell you how valuable that life is. The dear Lord alone can do that."

Volpe will speak at the awards banquet, and he will present the grand prize to the University of British Columbia, whose entirely student-built vehicle performed poorly on emissions (with a four-cylinder, 60-horsepower engine running on liquid natural gas), fairly well on energy efficiency, well (with a rubber-coated metal bumper) at the barrier, and excellently on safety and tests of handling, parking, and driveability. Though third in overall scoring, it will win because it made it through the 50-mile energy efficiency run. The U.B.C. team was the largest and best financed of the competition.

At the end of Volpe's otherwise standard banquet speech: "The cars that have run at G.M.'s magnificent Milford facility this week in competition with each other are worthy competitors." This is what he says, but the sentence that had been written did not end there. That sentence, deleted from the printed text just before the banquet, would have continued: "—with the best Detroit has to offer. These are no ivory tower dream machines. They meet the classic tests of automotive performance. They have been evaluated for customer appeal. But what really counts is the many ways they meet the acid test of urban acceptability." Words almost spoken. How easy to go too far, to say too much.

Instead, Volpe ad-libs: "I was delighted to hear that although you were competitors, you were never adversaries." He then continues with the printed text.

This writer asked G.M. Vice President Starkman about the risk of bad press and misinterpretation of results. "This," said Starkman, "is all part of the game."

Electricity

Electric cars finished first, second, and fifth in overall scoring, and an electric hybrid—with both an electric motor and an internal combustion engine—finished fourth; but the three all-electric cars did not make it over the 50-mile energy efficiency run and could not be considered for the overall prize. The U.V.D.C. thus proved an already known conclusion: that electrically powered vehicles might be the answer—but they are of limited practicality with present battery technology. Each type of battery seems to have its liability: weight, life, time required to recharge.

Assume it is decided that a car must be capable of cruising at 60 m.p.h. for four hours, for a range of 240 miles. If a car cruising on a highway at 60 m.p.h. dissipates 8 horsepower, then 8 hp. for 4 hours, or 24 kilowatt-hours, is required. The ordinary lead-acid car battery weighs about 20 pounds and provides 12 volts and 60 amp-hours, for a result of .72 kilowatt-hours per battery. Then a car would require 34 batteries (at a weight of perhaps 680 pounds), a motor, and a transmission. Since in actuality a car would require a power source generating considerably more power than that dissipated by the car against the road, weight and bulk quickly become nuisances and finally become prohibitive.

There are other benefits than lack of pollution from an electric car. Most electric car designs incorporated "regenerative braking." The car is slowed by slowing the motor, which induces a voltage which helps recharge the batteries. Braking is steadier and surer than a mechanical constriction of motion at the wheels, indicating the general advantage that electronic controls are more precise than mechanical ones.

The University of Western Ontario's car (which finished at the top of both scoring and S.I.M.) used 20 6-volt lead-acid batteries, and ten 12-volt lead-cobalt batteries (apparently merely a lead-acid variant) as backups. The team expected a range of 50 to 75 miles at 30 m.p.h., a maximum speed of 60 m.p.h., and acceleration from zero to 45 m.p.h. in 15 seconds. The car had a tubular frame, a honeycomb material between its exterior fiberglass shell and the interior lining for energy absorption in a crash, and a hydraulic bumper which performed decently at the barrier. Having failed to persevere through the energy efficiency test, it was given the electric car award.

The University of Florida vehicle, fifth in S.I.M., fourth in overall scoring, won in the category of electric

hybrid. Its small internal combustion engine, running on ordinary gasoline, drives a generator for two electric motors positioned at the rear wheels. A bank of batteries is available for sudden demands on power, (the car can run in modalities where the motors are powered by the engine or the batteries or both) and the motor can be used to recharge the batteries. Vehicle speed is managed with an electronic control. The car is accelerated by stepping up the voltage across the armatures of the motors, from 24 to 96 volts in four steps. The car has eight 12-volt lead-acid batteries, in polypropylene cases, for a total weight of under 300 lbs. The motors are of the sort used in jet aircraft; they operate at 50 volts and draw a maximum current of 500 amps. during sharp acceleration. The car's foam bumper suffered no damage in a 5-m.p.h. collision; the car rated decently on safety, and the small engine performed unspectacularly on emissions.

The University of Maryland team worked on two U.V.D.C. entries, but only one was ambulatory at the G.M.P.G. In one design, they switched from a hybrid to an all-electric plan when their "torque converter never materialized"; the hybrid, they decided, was "too inefficient and complicated." That original plan called for an engine-driven alternator which would power a motor or charge batteries. The engine would run at a constant speed so it could be designed for maximum efficiency. The abortive torque converter—the design was patented by a team member—would have allowed the engine to power the car at a variety of speeds while its own remained constant.

When all this fell through, the team switched to an all-electric car using 6-volt lead-acid batteries to provide 72 volts to a 20-h.p. motor. It was this car that finished fifth in the overall standings. Its foam bumper sustained no damage in the 5-m.p.h. crash, so it was given a barrier award.

The Maryland team's second car was to be an electric vehicle based on zinc-air batteries (lighter than lead-acid batteries for equal storage of energy) in which a reaction forms zinc oxide from zinc and oxygen. The plan was for four 30-volt batteries together with pumps, blowers, and heat exchanger, in an 8-cu-ft. compartment. This 800 pounds and $9,000 worth of batteries would give, they hoped, 40 kwh. of energy and a range of 160 mi. at 45 m.p.h. The zinc-air batteries, too, failed to materialize until it was too late.

Sobriety

Though they will probably infuriate those who are already annoyed at cars that audibly protest when seat belts are not fastened, drunk detectors will require that the driver play a game with his car, and win, before the car will take him anywhere.

Several U.V.D.C. entries had such devices, but the circuitry of some did not make it to the middle of the week, when professional alcoholics were to have been given 100-proof vodka, and then the cars, on a deserted runway at an airport. The U.V.D.C. organizing committee found "three and a half" detectors operational at midweek, and cancelled the tests. It was raining anyway.

The M.I.T. entry's drunk detector presents the driver with a rectangular pattern of four lights, one of which will become lit a random time interval after the would-be driver initiates the test. If it is one of the upper two, the driver must push a button on the same side of the matrix as the light; if it is one of the lower two, he must push the opposite button. The device tests the correctness of the response, and the time required. Each driver authorized to use the car has an ID card which is presented to his vehicle. The detector can then compare the response time to a computed average of his responses which the machine keeps in its memory.

To eliminate cheating, the detector will reject any time above a national standard, and, since the M.I.T. team believes that this standard will be only tenths or hundredths of a second above a normal response time, the testee will be unable to dawdle in the hope of impersonating another driver.

If the driver fails, the car is unstartable for a given time period, perhaps a half hour, at which time the driver is given another chance. If the car stalls, the detector does not come on on-line for one minute.

The M.I.T. entry, a Mazda with a Wankel engine running on liquid petroleum gas (its emissions and energy efficiency results were undistinguished), won a safety award. In addition to the drunk detector for which it was cited, the car's hydraulic bumper survived the barrier without damage.

Among the other safety features which it shared with many other entries:

☐ Roll-bars are common in racing cars but uncommon in production-line products, perhaps because they mar the lineaments of the great god Automobile's roof in placing bars across it to withstand an overturning. The roll-bar serves a second purpose: passenger harnesses

One vehicle fueled by hydrogen beat the federal emission standards for 1975 and 1976. But whether it would still do so after 50,000 miles, as the government will demand, is unknown.

can be attached to it vertically, rather than to the sides of the car at an angle. In addition to increased comfort, the driver is not yanked sideward in a collision.

☐ Seat belts should wrap around the pelvis rather than the abdomen. They must keep deceleration below 40 g's, and jerk at the onset of deceleration below 3,000 g.'s per second. In the M.I.T. design, the yoke of the belt-harness assembly passes over the roll bar to inertia reels on the floor, which allow slow play-out of the belts. Above three g's, though, they lock. By comparison, hard acceleration of a car is at about 0.4 g's, and hard deceleration is at about 0.8 g's.

☐ M.I.T.'s entry was one of the few with periscopes, and theirs, with three plane mirrors, had the widest field of view but was the bulkiest.

The Fuel of the Future

Near the bottom of the U.V.D.C.'s overall scoring—finishing 59th and 60th in a field of 65, and with S.I.M.'s higher than that of only one other vehicle—were the two entries from Brigham Young University. But that was no disappointment, for the B.Y.U. team had competed for one prize—emissions—and with one purpose: "To demonstrate the feasibility of eliminating automobile pollution by using hydrogen as a fuel." One of the B.Y.U. cars was the only non-electric entry in the competition to beat the 1976 federal standards—though whether it would still do so if it were driven the 50,000 miles required by the standards, or if it were one of a mass-produced multitude, is unknown.

The combustion of hydrogen to produce water vapor requires two hydrogen molecules to each oxygen molecule. In fact, oxides of nitrogen are also produced, and NO_x is the sole emissions problem inherent in hydrogen combustion.

The inherent difficulty in hydrogen as a fuel is backfire and knock. Both are results of hydrogen's high flame velocity.

Backfire, or preignition, results when combustion of the fuel spreads out of the combustion chamber and back up the line of fuel supply; this can occur in multi-cylinder engines containing valves whose openings during the combustion cycle may overlap with those of other valves for other cylinders. (The other possible cause is a hot residue of valve lubricating oil that accumulates in the cylinders and can chemically alter and prematurely ignite incoming hydrogen.) Backfire tends, then, to be peculiar to cars containing valves, so the valveless Wankel rotary engine has no backfire problem.

Knock is caused by the unevenness of combustion of hydrogen in the combustion chambers.

The B.Y.U. team began with a series of computer simulations. The initial consideration was for fuel efficiency. The mixture of hydrogen and air that the computer predicted would produce the highest combustion temperature, and hence the greatest thermal efficiency, was somewhat richer, at 3 parts to 97 parts, than the stoichiometric ratio—this to offset, B.Y.U. supposed, "incomplete gas mixing" in an engine's combustion chambers. While the easiest way to reduce the emission of nitrogen oxides, the computer found, would be to use either a very lean or a very rich fuel-air mixture, the loss of power in the former and the fuel inefficiency in the latter induced the team to seek other means of emissions control than moving the air-fuel ratio away from the optimum for efficiency.

Tests indicated two possibilities. While recirculating the hot exhaust gases did not seem to help much, cooling the exhaust before recirculation helped tremendously. And the injection of water into the hydrogen as it was delivered to the engine showed promise as well.

The team designed two vehicles. The first, a Mazda with a Wankel engine, would have its carburetion modified to handle hydrogen and would recycle part of its exhaust. The Mazda would be designed to convert from hydrogen to gasoline combustion "by flipping a switch on the dash."

B.Y.U. hoped to build the second vehicle from scratch, but time was lacking. Instead, they modified a Volkswagon Superbeetle's carburetion for hydrogen combustion and used the then-useless gasoline system to store and deliver water from the gas tank via the fuel pump for injection into the hydrogen in the carburetor.

The Superbeetle's four-cylinder, 50-h.p. engine, when operated without water injection, experienced "extensive preignition and cylinder detonation." But it was discovered that the water injection system reduced the flame velocity of the gas as well as the emission of NO_x, and, at a flow rate of 3.2 gallons of water per hour while the engine ran at 2,000 r.p.m., all was well. Since water vapor is produced by hydrogen combustion, the team proposed (but could not implement in the time they had available) the reclamation of at least a part of the required water from the exhaust.

B.Y.U. developed a safety system and installed it in both cars. Included were excessive-flow valves inside the hydrogen tanks, to close

The U.V.D.C. may have demonstrated a potential for conscious anticipation by engineers of the impact of their work. But is there a darker view in which man's ability to control the products of his mind becomes doubtful?

when the hydrogen flow from the tanks exceeded a predetermined level; and a lock-off solenoid, placed in the fuel line immediately after a pressure regulator, to cut off the supply of gas in the case of small leaks, or when the car is turned off. In an accident, the tanks themselves "are very rigid and would be disengaged from their mountings before rupture."

The emissions testing for the Mazda produced the following results, expressed in grams per mile: .40 hydrocarbons, compared with .41 required by 1975; .97 carbon monoxide, compared with 3.4 required by 1975; and, unfortunately, .86 NO_x, compared with .40 required by 1976.

On August 10, the Superbeetle with water injection was tested: .07 hydrocarbons, .78 carbon monoxide, and an enormous 2.50 NO_x. A spring in the choke had broken.

The car was repaired and retested: .07 hydrocarbons, .24 carbon monoxide, and .26 NO_x. The three federal standards had been beaten. But it should again be emphasized that the car had been driven 25 miles, not 50,000, and it was carefully prepared for this test; it had not been abducted from a production line.

At U.C.L.A., another team with an affection for hydrogen performed tests on a six-cylinder Chevrolet engine. It ran smoothly above 30 per cent of the stoichiometric ratio of fuel to air, but at 65 per cent the engine began to knock and lose speed. The team found *their* maximum fuel efficiency at 45 per cent of the stoichiometric ratio, less than half as rich a mixture as that used by the B.Y.U. team. This leanness produced without further control a low NO_x emission rate, they reported to a U.V.D.C. symposium in May, 1972. But "preignition and backfiring through the carburetor were consistently observed whenever the coolant temperature rose above 160°F." Recirculation proved to solve the problem for U.C.L.A.: "The exhaust gas is relatively inert and slows down the combustion process by decreasing excess oxygen in the mixture."

On Sunday, August 6, members of the U.V.D.C. coordinating committee nervously walked along the line of entries forming at The Pit, listening to reports of cars damaged—some seriously—in transit to the Proving Ground. They stopped beside the U.C.L.A. car. It was just fine. Music was issuing loudly from a cassette player installed in the passenger compartment.

The results of emissions testing for U.C.L.A.: .20 hydrocarbons, .44 carbon monoxide, and .85 NO_x. U.C.L.A. was unhappy with the hydrocarbons result; lubrication oil was getting into the combustion chambers.

Dare one imagine a hydrogen-fueled vehicle whose exhaust releases the required quantity of hydrogen gas from storage in solid form as a metallic hydride and then, cooled and recirculated, reduces engine knock, backfire, and the emission of NO_x? Accepting the overall prize in the internal combustion engine class, the U.C.L.A. team said that they hoped their entry might presage "a long, hard look at hydrogen as the fuel of the future."

Cruise Control

In a "Study of the Impact of the Clean Air Car Race and the Urban Vehicle Design Competition on Engineering Education," dated November, 1971, U.V.D.C. co-ordinating committee members proposed that "the engineer [should] form the interface between social and technical realities . . . [serving] as guardian of the public interest with respect to technology, operating at the fundamental level where technology is created." But they noted that "engineers have always been more aware of and sensitive to the effects of their work than have been the managers who direct engineering work and the sources of capital which implicitly decide what work shall be done. Thus, the new idea of engineering requires that engineers . . . must have some power to implement their social awareness."

But the issue may not be so simple. A competition such as U.V.D.C. may be a demonstration of the potential for conscious anticipation and control of the impact of the engineer's work, yet there is a darker view in which the works of technology take on singularly nonutilitarian aspects and man's ability to control the products of his own mind is profoundly doubtful. Tail fins, lineaments, dashboard—in short, automobile styling—clearly demonstrate a psychological principle; in an advanced sort of animal, such as man, deeper urges than anything as simple as survival needs become evident—and even predominate over the basic biological needs. A desire for safe, or even efficient, transportation has never sold many automobiles.

The impact of the automobile, then, goes beyond pollution, beyond the superhighway system and cities designed for, and subservient to, the automobile. Beyond the effects of the car upon the human body, and then upon the human community, how is the impact of technology upon human psychology to be measured and dealt with?

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TR-71

Trend of Affairs

Trends This Month

CHEMISTRY

An experimental catalyst, in its time, plays many parts.

ENERGY

To obtain electricity directly from heat: thermionic emission . . . To obtain oil: we enter a seller's market . . . and "explore" the fields we already know.

SYSTEM DYNAMICS

You don't have to be pessimistic to love world-modelling . . . One city's history is close to the "urban dynamics" general simulation.

EARTH, MOON AND SUN

This year's eclipse: not too bad, as a rehearsal for next year's . . . Lunar mineralogy without the field-trip.

CITIES AND TOWNS

Suburban affluence may price itself out of existence . . . Factory housing may yet pay off . . . A scheme to stop the leaks in federal assistance.

OCEANS

International law and order—if the nations want it.

COMMUNICATIONS

Loud enough to be a nuisance, sirens are too quiet for their purpose . . . A really new medium—beams of muon particles.

CHEMISTRY

Of Cobaltites and Cars

Lanthanum cobaltite, one of a group of compounds which in July set off alarming oscillations in the price of platinum, and of stock in Engelhard Minerals and Chemicals Corporation, has in its short history as a catalyst attempted three different roles in the ever-popular drama of the clean-air car. Its latest, in which it featured as a rival to platinum for catalyzing the oxidation of carbon monoxide to carbon dioxide, was by far the most crowd-pulling of the three.

Somewhat over two years ago, a researcher at Britain's Central Electricity Research Laboratories (Leatherhead, Surrey) announced (*Nature*, May 30, 1970, pp. 847-8) that lanthanum cobaltite seemed to be a good material for electrodes in rechargeable metal-air batteries. In such batteries, incoming oxygen (from the air) must be reduced to the OH group, and the same reaction must go in reverse at the same electrode during recharging. Such batteries, said D. B. Meadowcroft, appeared to be the leading contender for use in electrically-powered urban vehicles, except that the oxygen reactions would probably need a platinum catalyst, which would be expensive. He had tried using metal-oxide semiconductors as electrode materials, and in the process had hit on lanthanum cobaltite.

He suggested that a solid $LaCoO_3$ electrode might give the same performance as a platinum-surfaced one, at far less cost (for large quantities—heavily doped with strontium for better electrical properties—about £1/kg.). Substituting chromium for the cobalt did not work, while substituting praseodymium for the lanthanum (both belong to the rare-earth group of metals) did. All these variants, Mr. Meadowcroft noted, have a crystal-structure known as perovskite-like—a type of cubic.

At the University of California, Los Angeles, a group that included W. F. Libby had been studying the catalytic activity of perovskite-like oxides. Their response to Mr. Meadowcroft's discovery was to try lanthanum cobaltite in a quite different reduction reaction: instead of reducing oxygen in a liquid electrolyte, reducing hydrocarbons in the gaseous state. They found that it did indeed catalyze the addition of hydrogen to an unsaturated hydrocarbon. Quoting Mr. Meadowcroft's estimate of the bulk price, Professor Libby suggested that lanthanum cobaltite should be tried as an auto exhaust catalyst (*Science*, 5 February, 1971, pp. 499-500).

Dr. Libby's sample of lanthanum cobaltite was prepared on the other side of the country at Bell Telephone Laboratories, Murray Hill, New Jersey, by J. P. Remeika, via the good offices of B. T. Matthias, who works both at Bell Labs and at the University of California (San Diego). Professor Matthias is of course best known for his success in finding combinations of metals which will work as superconductors at remarkably high temperatures, and for his satirical attitude toward theoreticians who fail to do the same.

He and Mr. Remeika shortly began to collaborate, at Bell, in what is described as a fundamental research project concerning the relation of the catalytic activities of materials to their crystal structures and other physical properties. Within the first year the Bell team—whose other members include R. J. H. Voorhoeve and P. E. Freeland—had studied between 50 and 100 substances, and discovered that lanthanum cobaltite and a number of other perovskite-like rare-earth oxides catalyze yet another reaction of interest to the auto industry: this time an oxidation, namely that of carbon monoxide to the dioxide. Among the other successful catalysts were a range of rare-earth manganites containing lead —$La_{1-x}Pb_xMnO_3$, where x could be anywhere between 0.4 and 0.6, and the

analogous manganites of praseodymium and neodymium. For comparative purposes the team used a platinum-on-ceramic catalyst, from Engelhard, which they crushed and sieved to render it similar to their test specimens.

In spite of some doubt as to what the effective surface area of the platinum catalyst really was, it would appear that at least some of the cobaltites and manganites were about as effective as platinum in the laboratory conditions —ie., with a gas consisting only of carbon monoxide and oxygen, at temperatures around 200°C. and flowing at 30 cu.cm./min.—and that one of the lead-bearing compounds was degraded appreciably less rapidly than the platinum when a lead compound was added to the gas stream. (Mr. Remeika, speaking to the *Review*, said that a catalyst might in principle be degraded by lead in one of two ways: by surface coating or by chemical reaction. The latter will be unlikely if the position that the lead would occupy is already taken up.)

Neither the title of the Bell team's report (*Science*, 28 July, 1972, pp. 353-4) nor the alert Murray Hill news staff made any secret of the possible implications for the platinum-catalyst business. Engelhard, which had only two weeks earlier become the major supplier of monoxide-treatment catalyst systems to the Ford Motor Company, moved very fast indeed to draw a series of distinctions: between a finished system and a laboratory sample; between a real car exhaust mixture and the gas used in the Bell tests, as regards both composition and flow-rate; and between an uncrushed Engelhard product and a crushed one.—*F.W.*

ENERGY

Thermionic Power?

Work continues on the application of the thermionic-diode principle—the emission of electrons by a hot surface —to the generation of electric power. Up to now most of this work has been done in the U.S.S.R., U.S.A., France and West Germany. In all four countries, the principle aim is the development of practicable thermionic nuclear reactors, i.e., reactors of which the fuel elements consist of a number of thermionic diodes connected in series, so that the electrical energy is produced right inside the reactor core with no intermediate generator stages and no moving parts.

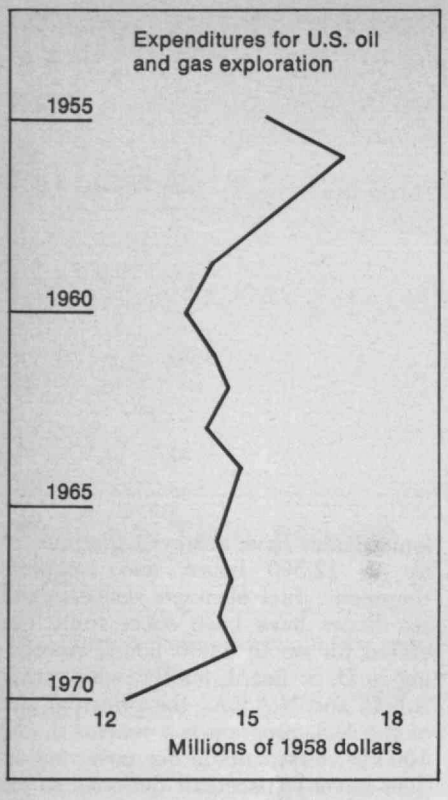
At the Third International Conference on Thermionic Electrical Power Generation, held this summer at the Nuclear Research Centre in Jülich, W. Germany, it was apparent that the Soviet Union is way out in front. A full-scale test reactor, completed early in 1970, was successfully operated for 1500 hours (Experiment Topaz 1) with an output of between 10 and 15 kW. A second core installed in the middle of 1971 (Topaz 2) was run for 6000 hours—1500 at full power. Trials with the third core (Topaz 3) are continuing.

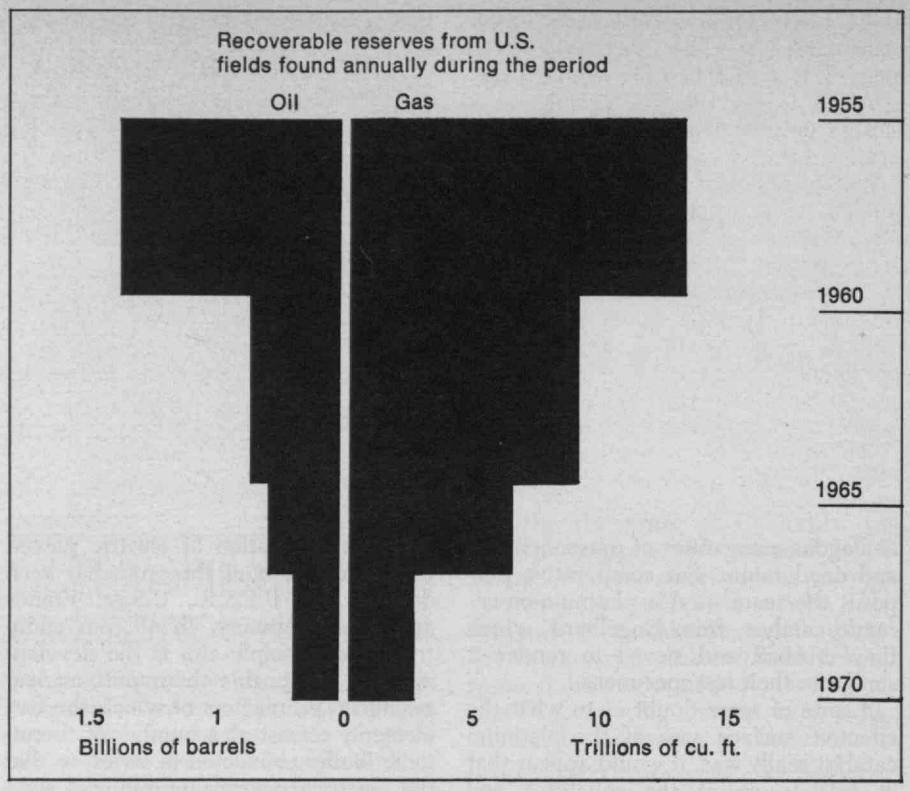
According to Prof. Morochow, Vice President of the National Committee for the Application of Atomic Energy, Moscow, two kinds of reactors are in the process of development: moderated reactors for outputs of up to several hundred kilowatts, and fast-neutron reactors for still larger outputs. Now that it has been shown that such reactors work, current effort is being concentrated on refining them into economic propositions. In spite of the numerous technical difficulties still to be overcome (relating to energy-conversion efficiency, radiation screening, electrode surfaces and compatibility of materials, for instance), the Russians expect to have thermionic reactors suitable for powering TV-communication and weather satellites by 1975.

In the U.S.A. a laboratory thermionic converter with external electrical heating and an output of 8 W./sq.cm. passed the 40,000-hour mark in April this year. In research reactors, thermionic diodes have achieved lifetimes of up to 12,500 hours, and complete thermionic fuel elements consisting of six diodes have been successfully operated for up to 4,000 hours. According to D. S. Beard, jointly representing A.E.C. and N.A.S.A., the principal aim of the U.S. program is a reactor in the 100-kW. class suitable for powering an (ion-driven) spacecraft designed to explore interplanetary space beyond the Mars orbit. By the beginning of the 1980s, he said, units should be available which, with emitter temperatures of 2000°K. and current densities of 12 A./sq.cm., will have a useful lifetime of two years, and at 1800°K., five years.

In France the prospects of thermionic reactors being used in spaceflight are not regarded as very good, and the main emphasis is on underwater applications. J. Pecquer, of the Commissariat à l'Energie Atomique, described the possibility of using nuclear reactors to power oil and other mineral prospecting stations anchored to the ocean bed at depths greater than 300 m. and more than 300 km. from land, where a cabled power supply from a ship or from the coast ceases to be feasible. In the course of the current "Diogène" program, thermionic diodes have achieved lifetimes of 25,000 hours in the laboratory and 5,000 hours in the reactor. Considerable detailed work still remains to adapt the units to ocean conditions, and a decision on the construction of a prototype is not expected before 1974. It is suggested that construction on a commercial basis could possibly begin around 1980.

In W. Germany, work has been in progress since 1969 on a thermionic reactor designed principally for TV satellites powerful enough to transmit direct to individual home antennas. In the course of this program thermionic diodes have been operated for up to 28,000 hours in the laboratory and 3,700 hours in the reactor. The first experimental fuel element, consisting of three diodes, has so far been in opera-





Expenditures for oil and gas exploration within the continental U.S. have been essentially constant during the period from 1955 to 1970, but additions to the nation's supplies of oil and gas resulting from the new explorations have dropped steadily—another way of saying that less and less new resources seem to remain to be discovered in the U.S.—not including Alaska. Throughout this period, total computed U.S. gas reserves have declined but total continental oil reserves have remained almost constant—the result of improved secondary recovery methods applied to supplies remaining in existing fields.

tion for 1600 hours in the FRJ-1 reactor at Jülich, and a second similar trial was recently begun. A governmental decision on whether or not to go ahead with the next stage of the program, a 20-to-30-kW. prototype reactor, is expected in a few months.

On the whole the Jülich conference indicated that the development of thermionic fuel elements is now sufficiently far advanced for the Western nations to follow the Russian example and construct thermionic trial reactors. However, further development along the same line is likely to be extremely costly, and at present there are few indications that thermionic reactors are likely to yield sufficiently great advantages over other sources of power (such as, for space applications, solar generators) to justify the expense. It is therefore doubtful whether individual nations could reasonably afford to risk going it alone. In view of this, a majority of the delegates, including the Russian representatives at Jülich, spoke of the desirability of some form of international cooperation.—*David Marks*

No "Cheap" Oil?

Some large, well lubricated numbers about energy, Venezuela, and the U.S.: Oil represents 90 per cent of the value of Venezuela's current exports, and half of that total is now sent to the U.S.—over 1.5 million barrels per day. In turn, Venezuela is the fifth largest purchaser of U.S. goods in the world.

Venezuela has proven reserves of 14 billion barrels and claims ten "very promising" new areas where oil *in situ* may approach 1,000 billion barrels.

"It can now be understood," said Hugo Perez La Salvia, Venezuelan Minister of Mines and Hydrocarbons, speaking to the Pan American Society of New England during the summer, "why we attach the utmost importance to our oil revenues. . . .

Dr. Perez, who graduated from M.I.T. in 1945, used his figures to try to convince himself and his audience "that the oil market has become a seller's market in the last two years." But the plain fact is, say some M.I.T. economists (*see below*), the growth rate of world petroleum demand has now fallen enough to create serious overcapacity.—*J.I.M.*

New Oil From Old Fields

If the threat implied in Hugo Perez La Salvia's remarks (*see above*) is not so real after all, how so?

Speaking at the Rocky Mountain Petroleum Economics Institute on almost the same day Dr. Perez was in Cambridge, Morris A. Adelman, Professor of Economics at M.I.T., confirmed that the results of investment in oil and gas exploration in the continental U.S. in the past two decades—the 1950s and 1960s—are not so very different—generally poor.

There has been "a severe shrinkage" in the number of significant crude oil discoveries resulting from an essentially constant exploration investment. Indeed, in 1969 not a single large oil field was found in the continental U.S. A similar picture of declining discoveries can be shown for natural gas.

Yet despite this failure to add new fields to both oil and gas inventories, U.S. oil added per unit of development investment has been relatively stable; the cost per barrel has increased in a decade largely because of the higher cost of money and faster depletion rates. The gas industry, in contrast, has behaved as expected. Published gas reserves have dropped and development costs per added unit have soared. Why?

It is because the petroleum industry has learned to capitalize on innovative "secondary recovery" processes which can be made to yield considerable increments of oil from known fields—sometimes, indeed, more than all the oil originally estimated to be there.

Thus, said Professor Adelman, there is "a huge cushion" of known but not

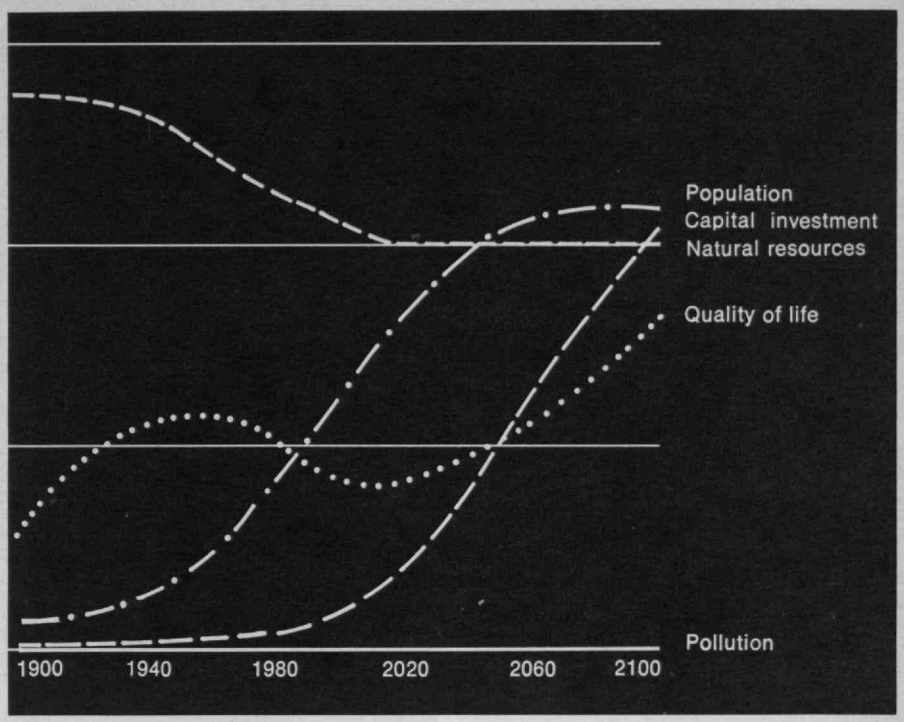
fully developed reservoirs being gradually added to reserves at modest expense. "It would be only a mild exaggeration to say that the petroleum industry devotes itself to creating new crude oil reserves out of old fields."

At the American Chemical Society's annual meeting this fall, Dalton C. Mac Williams of Dow Chemical U.S.A. said primary production generally realizes only one-fifth to one-third of the total oil potential in any given field.

Not so for gas, a very large proportion of which is recovered in the primary phase. Secondary recovery is relatively fruitless; as Professor Adelman puts it, "oil clings to rocks; gas does not."

How long can this era of low-cost domestic oil reserves continue, as we press ever harder on the remaining oil in known fields? No one knows. Professor Adelman's only conclusion is that "the domestic oil industry should not be counted out too quickly."

What about U.S. resources on the Alaskan North Slope, omitted from Professor Adelman's analysis? They were omitted for good reason: no one knows what will be the cost of oil from them in any category—exploration, development, or production. We can do without the North Slope oil until the environmental problems are resolved, whenever that is, said Professor Adelman; but the cost data "are sorely missed," he said.—*J.I.M.*



An alternative to Professor Jay Forrester's computer-based predictions is this optimistic forecast, which was generated with an essentially similar model, but incorporating a set of beliefs of the type "Technological progress will circumvent materials scarcities." The author of this alternative simulation of the future, Robert Boyd of the University of California, tells the *Review* that he is himself far from being an optimist—he has merely programmed an optimistic computer model: "I don't believe in my model any more than the original."

SYSTEM DYNAMICS

The Dynamic World Optimist

The proponents of the "limits of growth" view of our civilization's future hold that material growth—growth in the rate of consumption of resources—cannot continue indefinitely on a finite planet; that our present way of life is closely tied to a continuance of the growth to which we are accustomed; and that this growth is liable to encounter the planetary limits within a period on the order of a century, with catastrophic consequences for our whole culture (unless we change our ways more radically than is to be expected on the basis of past form). This view, since last year, has become associated with the names of Professor Jay W. Forrester, of M.I.T., and Professor Dennis Meadows (now at Dartmouth College, New Hampshire) and his co-workers, thanks to their success in modelling the limits-of-growth scenario on computers.

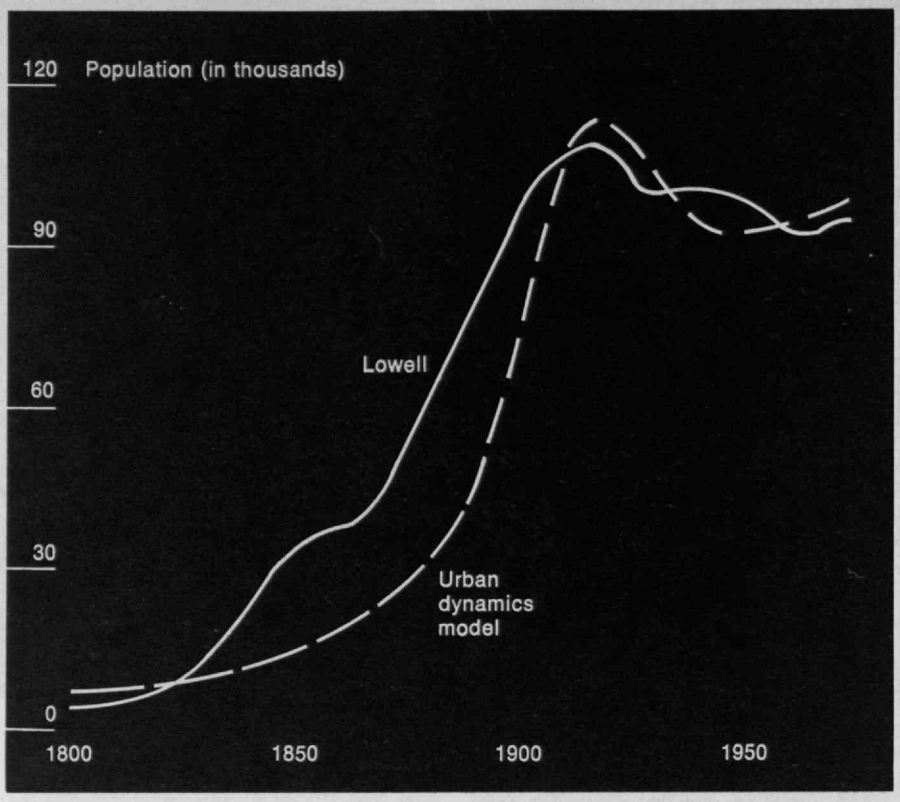
Robert Boyd, of the Department of Zoology at the University of California, Davis, terms this picture of the future "the Malthusian view," in contradistinction to what he calls "the technological-optimist view." The technological optimist believes that as scarcities arise, alternative materials will always be found; that technology will continue to progress, raising the standard of living, in response to which the birth-rate will fall; and that therefore the day of doom is not at hand. Opponents of the Forrester-Meadows thesis often voice this opinion, but seem not to have reinforced it with computer simulations, thus leaving themselves at a disadvantage. Technological progress, however, must inevitably raise the standard of interprophetical debate, and Mr. Boyd has now supplied this need (*Science*, 11 August, 1972, pp. 516-519). Starting with the "fundamentally Malthusian" world-model presented in Professor Forrester's book *World Dynamics* (*see also* Technology Review *for January, 1971, pp. 51-68*), Mr. Boyd makes a number of changes. First, he inserts a new variable, "technology", defined for the purposes of the model by its effects: as it increases, it raises the amount of food available, and lowers pollution and resource-consumption per unit of production (to such an extent that complete non-pollution and the use of nothing but recycled materials are placed within practical reach). Technological progress is assumed to be stimulated both by the availability of capital and by any perceived decline in the quality of life. The coefficients of these relationships were "invented from whole cloth . . . to reflect, in a reasonable way, the technological optimist's faith."

In addition, Mr. Boyd makes the birth-rate fall rather faster with increased material standard of living than does Professor Forrester, and rejects the latter's classically Malthusian assumption that if more food becomes available the birth rate will rise appreciably. (As a source for the former modification he cites an earlier Forrester work, *Industrial Dynamics*.)

The essence of the result of all these changes is shown in the graph. World population levels off, about a century hence (at 15 billion). Fifty years from now, progress in the technology of recycling halts the consumption of natural resources completely while there are still quite large reserves remaining. The quality of life is pulled out of its immediate recession and begins to climb to unprecedented heights (although another aspect of the quality of life, relating to population density alone, sinks to a very low level on another of the author's graphs, not shown here). Pollution—which is plotted here on the same scale as was used by Forrester—never begins the rise which Forrester's model predicted for the near future.

From this finding, that the same basic world-model gives optimistic results when adjusted according to the beliefs of technological optimists—beliefs which are held by at least some reasonable people—Mr. Boyd concludes that the model "is completely unable to resolve the technological-optimist/Malthusian controversy"; and that the *World Dynamics* simulation alone "is far from useful as a policy tool" because it leaves the policy maker no better off than he was before. ("Instead of being faced with an array of unverified mental models, he is confronted with an equal number of conflicting computer simulations.")

But a model that might be a practical policy tool would not be very different. It would be based upon the same methodology, which has the capacity to absorb expert opinion from all sides into a single network of relationships; but "a large number of more disaggregated state variables would allow experts in various fields to involve their knowledge more usefully."—*F.W.*



Urban dynamics—the computer-based analysis of the growth and decay of a city developed by Professor Jay W. Forrester at M.I.T.—"describes all cities but none in particular," writes Walter W. Schroeder, III, in a master's thesis for M.I.T.'s Sloan School of Management. But can it describe and thus be directly useful to a single city? As a test to support a proposal for research funds from the Department of Housing and Urban Development to answer that question, Mr. Schroeder compared population growth projections from the general urban dynamics model with that experienced by Lowell, Mass., in its first 150 years; the similarities, said Mr. Schroeder, "strongly suggest that the forces which have produced Lowell's history are also found in the model."

Urban Dynamics Tested in Lowell

Lowell, Mass., looks like any of a score or more aging, middle-sized New England cities: a compact web of wandering streets, tangled with cars and faced by undistinguished buildings accommodating more people or different enterprises than they were originally planned to serve. Neither prosperous nor poverty-stricken but with amply visible problems.

But are the visible problems the real ones? And how should a city such as Lowell resolve its conflicts and make a better life for its people?

Lowell's problem is not lack of effort. When Walter W. Schroeder III, as a graduate student, began studying the city's government and status in the Sloan School of Management nearly two years ago, he was immediately impressed by the effort and sincerity of the city's administrators and by the wisdom and skill of James Sullivan, Lowell's City Manager. What is lacking, Mr. Schroeder suggests, is a set of city priorities.

When he asked the two directors of the city's planning agency how many people they felt should live in Lowell, one answered "100,000" while the other answered "200,000." And when he asked 15 city officials to name the city's most crucial problem, there were almost as many different answers—housing, parking, unemployment, taxes, transportation, education, crime, inadequate revenues, and others.

A system which has no explicit long-term goals, says Mr. Schroeder, finds it difficult to define its current problems, "since problems are best defined in terms of the distance between desired and actual conditions.

"With no guiding mechanism for setting feasible urban goals, and with no strong ties between the urban planning and management functions, the long-term perspective atrophies. Immediate problems take on relatively more prominence, the 'correct' decision becomes harder to find, cities create administrative webs to deal with apparent problems, and the rigidity of this problem-solving network can work to the city's disadvantage. The actions of one decision-maker often produce results which are in direct conflict with the objectives of other decision-makers."

Thus, says Mr. Schroeder, "Administrators in Lowell today find themselves barely able to contain problems that they had originally hoped to eliminate." For example, Mr. Schroeder found that while the city's unemployment rate has been above 6 per cent for 30 years (and above 10 per cent for the past 5 years), city planners cited "parking" as the major city problem.

Lowell seems to be a classic example of the well-intentioned, but often short-sighted, decisions that Jay W. Forrester, Professor of Management at M.I.T., says have caused many urban programs to run aground. His view is that social systems—including urban ones—are perverse and behave in counterintuitive ways (*see his articles in* Technology Review—"*A Deeper Knowledge of Social Systems," April, 1969, pp. 21-31; and "Counterintuitive Behavior of Social Systems," January, 1971, pp. 52-68*), so that apparently obvious solutions can exacerbate problems instead of solving them.

Urban dynamics is the name Professor Forrester has given to a continuing computer-based study of urban development which shows how industry, housing, and people interact with each other as a city grows and later decays.

Is such a model—proposed only to describe an idealized urban system—useful to describe a single city, and so help that city understand what it must do to successfully confront the forces leading to its decline?

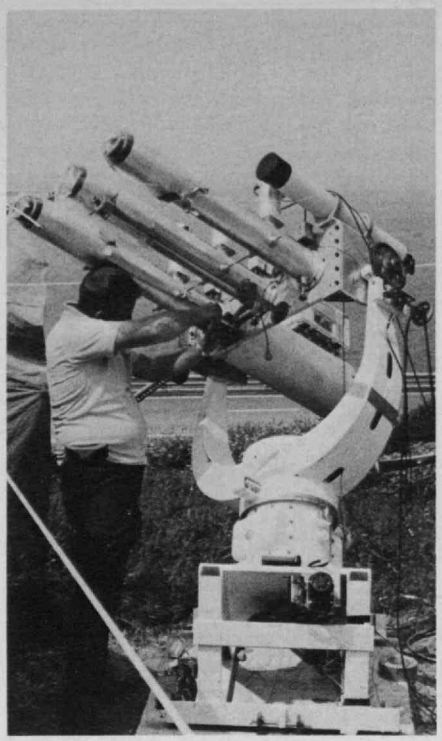
The question is by no means rhetorical, nor the answer certain. A grant from the Department of Housing and Urban Development to M.I.T. will make possible a test case involving

Lowell. "Because Lowell's problems are similar to those of many other U.S. cities," Mr. Schroeder believes that successful research into the dynamics of urban behavior there "may yield guidelines for urban problem-solving and priority-setting which would benefit nearly all cities in the future."

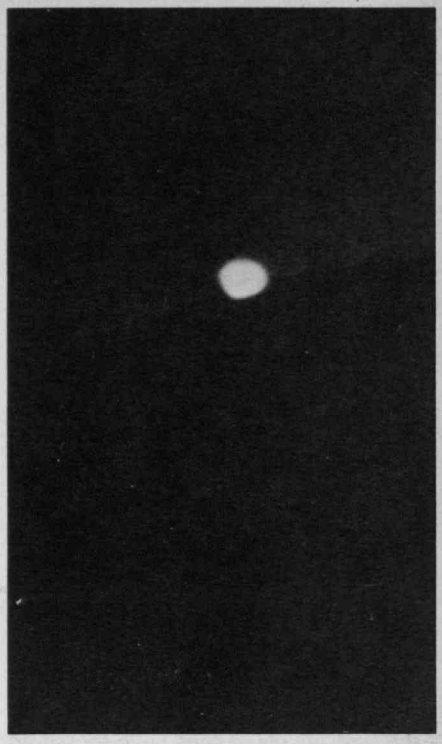
To show that a study of Lowell might be fruitful, Mr. Schroeder tried an example: can the general urban dynamics model describe the 150-year development of Lowell to date? It turns out that the model, when adjusted to Lowell's land area and normal land-uses, produces a 150-year population history which is strikingly similar to that of the real city. Indeed, Mr. Schroeder found that "from 1900 the model and the city are never more than 10 years apart." And he believes "there is every reason to expect that further model refinements will yield more precise projections of the city over the next 50 or so years."—*J.I.M.*

EARTH, MOON AND SUN

A Mediocre Eclipse



A group from N.A.S.A.'s Goddard Institute for Space Studies used three television-type cameras to observe the solar corona.



This photograph of a solar prominence was taken by two young amateur observers, Karl Lehmann and Mark Lambert, through a home-built reflector telescope.

With its short duration and dearth of outstanding observation sites, the total solar eclipse of July 10, 1972, was inevitably poor in comparison with its nearest neighbors, those of March 7, 1970, and June 30, 1973. But eclipses are rare, and even a poor one draws crowds to see what is both one of nature's most impressive shows and one of science's most unusual experimental situations.

Eastern Canada was the most accessible of the regions where the 1972 eclipse was total, and it was mainly here that the observers gathered. For most kinds of ground-based optical experiments, the best location was near the town of Cap Chat on the north shore of Quebec's Gaspe peninsula. Over 4,000 visitors more than doubled the town's population. The weather prospects were mediocre and the results were mixed. An M.I.T. group's experiments were ruined by a thick cover of clouds, but on the other side of the town the clouds broke long enough for a few observations.

An eclipse helps scientists study the sun and its effects on the earth. The sun is a nuclear furnace—but what mechanisms control the perturbations we observe on its stormy surface, and the changes in its magnetic field? What causes sunspots and flares to appear and disappear? Until these questions are answered, we cannot claim to understand our nearest star.

The bright disk we see in the sky is only a part of the whole—the inner part. The rest, with a diameter several times greater, is a region of hot, highly-ionized gas called the corona. Its wispy structure shifts about in step with other observable solar phenomena; but, seen from the earth's surface, it is less bright than the scattered light of the sky. With very carefully-made cameras installed atop high mountains, it is possible to observe the innermost, brightest part of it. More than that can be seen only during an eclipse, when the source of the scattered light is shut off. If we could escape all of the earth's atmosphere as astronauts do, all we would need to cause an eclipse would be a casually-placed thumb. But that technique has not been available to solar scientists; many complain they have been short-changed by N.A.S.A.

The other end of an eclipse is the earth, where scientific interest centers on the ionosphere—the region in which incoming solar radiation ionizes the air, and from which radio signals are reflected differently depending on whether it is daytime or night. The change is gradual with every sunrise and sunset, but only during an eclipse is it sudden.

There is a standard list of eclipse experiments: observing the shape, spectrum, and polarization of the corona; timing the beginning and end of the eclipse; checking radio propagation through, and reflection from, the ionosphere; and measuring its ion density.

Spectrographs and special cameras are used to record the features of the corona. But this year two groups, one from M.I.T.'s Planetary Astronomy Laboratory and the other from N.A.S.A.'s Goddard Institute for Space Studies, used television cameras instead of the photographic kind. Television systems are superior in their sensitivity, range of linear response, and compatibility with electronic data processing machinery (*See* Technology Review *for June 1972, p. 63*).

The Canadian National Research Council fired eight rockets from two locations to directly measure the ionization density of the ionosphere. The rockets also monitored reception of radio signals from the ground.

A means of squeezing a few extra seconds of duration out of an eclipse, and of avoiding clouds at the same time, is to observe it from an airplane flying in the same direction as the moon's shadow. This year Arthur N. Cox of the Los Alamos Scientific Laboratory led a successful expedition which chased the shadow along the Arctic Circle over Canada's Northwest Territories in a converted Air Force NC-135 cargo jet. Their principal experiments were corona observations.

For many of the experimenters, the 1972 eclipse was a rehearsal for next summer's spectacle over the Sahara. That eclipse, best visible from remote desert locations in Mauritania, Mali, and Niger, will provide up to seven minutes of totality—only half a minute short of the theoretical maximum—and it will be visible from places where clear weather will be virtually assured.—*O. Reid Ashe*

Exploring the Moon With Telescopes

Our age will have first-hand knowledge of only six or eight isolated points on the moon, for there will be only one more Apollo flight and probably not very many more Soviet flights. Any further explorations will have to be done by the traditional method: looking at the moon through telescopes.

But telescope observations will tell us more than ever before, thanks to the work of M.I.T.'s Professor Thomas B. McCord and his colleagues. The spectrum of light reflected from part of the lunar surface, they have found, can yield a great deal of information about its mineral composition.

Their technique works this way: The reflection spectrum of a region of the lunar surface is measured through an optical telescope in the wavelength segment between 0.3 and 1.1 microns. The region can be as small as one kilometer in diameter. Professor McCord and his colleagues have measured the spectra of several hundred areas; all show increasing reflectance with increasing wavelength, and all show a dip at about 0.95 microns.

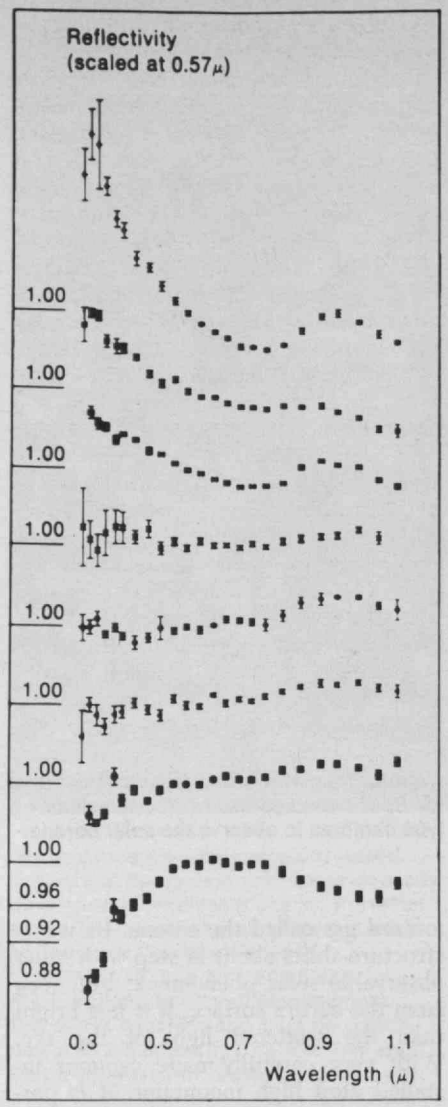
But it is the differences between the reflection spectra that are of interest. So Professor McCord converts the absolute reflection spectra into ratio spectra. A region's ratio spectrum is its absolute reflectance, divided (for every wavelength) by the reflectance of an arbitrarily-chosen reference point.

Lunar soil, like earth soil, contains millions of tiny mineral crystals. Part of the light striking the soil is reflected, but certain wavelengths are preferentially absorbed in the crystals and show up as dips in the reflection spectrum. Those are the wavelengths which can excite electronic transitions in ions in the crystals. The wavelength depends on the type of ion and the type of crystal structure around the ion.

But the spectrum measured through a telescope on earth involves averaging over all the minerals on the face of the soil, and over a rather large area. Fortunately, Professor McCord explains, "the mineral content within a particular region is uniform enough that you can say something quantitative."

The spectra from lunar materials are varied, but they can be grouped together by the shape of the intensity-versus-wavelength curve. Professor McCord has defined four non-intersecting groups of ratio spectra; they correspond to *mares,* uplands, and bright, recent craters in each.

In general, the freshly-uncovered material in a crater differs from the material surrounding it. Professor McCord has observed that everywhere on the moon the underlying material appears to have been covered over with a mixture of *mare* and upland material. Thus uplands are contaminated with *mare* material and *mares* with upland.



Reflection spectra of various portions of the lunar surface show small but very important differences; Professor Thomas B. McCord of M.I.T. and others working with him are learning to correlate the features of these curves with the mineral content of the lunar soil. These are ratio spectra, giving the reflectivity relative to that of a reference point in the *Mare Serenitatis.* They correspond to areas in (top to bottom) the Sea of Tranquility, the Sea of Moisture, the Luna 16 landing site, Apollo 14 landing site, the crater Le Monnier, another area in the Sea of Moisture, the crater Plato, and the Sea of Cold.

The key to the cipher lies in the samples of lunar soil returned by the Apollo missions. Analysis of the returned samples has shown that the main contributor to the features of the reflection spectra is a class of minerals called pyroxenes. These are magnesium-iron-calcium silicates, found both on earth and on the moon. The iron in pyroxene is the source of the 0.95-micron reflection dip. By looking at a portion of the lunar surface, one can tell (on the average) the kind and amount of pyroxene it contains.

Glass is also present in the lunar soil; its main effect is to "wash out" the dips in the reflected spectrum, causing a more even curve. Therefore the spectrum tells how much glass is in the soil, relative to other materials.

Another common lunar mineral is ilmenite, a titanate of ferrous iron. When ilmenite and pyroxene crystals are fused into a glass by the heat of a meteor impact, there becomes possible a characteristic electron transition between the iron and titanium ions in the glass. That transition shows up in the reflection spectrum and tells us about the titanium content of the soil.

It may become possible to extract even more information as research progresses, Professor McCord said, for "there are more characteristics in the curves that we haven't figured out yet how to interpret."—*O. Reid Ashe*

CITIES AND TOWNS

The Tattered Urban Fringe

Given technological change and human nature, the problems of the urban fringe are inevitable. And their persistence into the future is irrevocable. . .

. . . but with a difference. We have said that exponential growth of population and economy cannot continue, and it is in fact subsiding. In its place comes the new ethical problem of establishing a balance of power between man and the natural surroundings, and with it the threat of an ever-sharper delineation between rich and poor.

If the 100 visitors who came to M.I.T. last spring to learn about "The Future Character of the Urban Fringe"—a two-day alumni seminar—expected panaceas, or even a series of new devices to help tame the motel-lined four-lane highway and get to the realities beyond the rhetoric about housing poor and rich together, they were disappointed. There is nothing new under the sun.

Planner Without a Plan

Robert C. Wood, who directed the Harvard-M.I.T. Joint Center for Urban Studies before he became President of the University of Massachusetts two years ago, proposed that the pattern of suburban growth at the expense of center city will continue indefinitely in the U.S., despite the fact that it represents an "unproductive use of resources which penalizes us all." Consider the waste represented by typical suburban low-density residence

patterns: expensive public services, expensive transportation, and gross inefficiency in land use. But there is simply nothing on the horizon to make the pattern change.

The opportunity to make money through the development of land is now higher than ever before. Meanwhile, the U.S. has no national policy on land use and has had none since the 1860s, and we have no viable instruments for planning transportation and public services. It is, President Wood said, a "major indictment" of a nation "whose stock in trade is supposed to be planning."

The Narrowing Triangle

Though U.S. growth patterns will change from exponential to linear—a transition which has probably already begun, said Jay W. Forrester, Professor of Management at M.I.T.—our future situation may in fact be worse, not better. We have already exceeded, in at least some sections of the country, the levels of population and pollution which the earth can accept; as we try to right these problems, we will inevitably reduce production (or increase prices), even while population continues to grow. The result will be a "narrowing triangle"—fewer goods to distribute to more people, higher prices, growing economic inequality between rich and poor, intensified problems between city and suburb, between "haves" and "have-nots."

In the past, Professor Forrester suggested to the seminar, our strategies have been to transfer pressures from present to future—to build new suburbs and new highways by which to reach them, to build industrial parks on the urban fringe and pay welfare to the central-city workers who cannot afford transportation to reach the new jobs. But such strategies merely postpone the day of reckoning.

Our wiser course, urged Professor Forrester, is to choose now to increase pressures—to lower the differentials between rich and poor, for example, to end the policies which make land ownership—and probably misuse—our most profitable capital investment. Only thus, he believes, can we truly "avoid the cataclysmic pressures which we now try to postpone."

Robert C. Casselman, a management consultant who was instrumental in designing the new "cabinet" system for Massachusetts state government, thinks these apparently divergent forces may soon converge, after all. In another five or ten years, he said, the "limousine liberal" who lives in today's comfortable suburban home while saying all the humane things about urban poverty and blight will awaken to the truth: he has erected a structure in which he can no longer afford to live. His taxes, transportation, and maintenance will be more than he can carry.

Then—and only then, said Mr. Casselman—will we accept the compromises we now refuse: standardized housing to realize the economies of mass production, cluster zoning to increase density and reduce land costs.

Was the seminar itself composed mostly of "limousine liberals"? Melvin H. King, formerly Director of the Boston Urban League who is now Lecturer in Urban Planning at M.I.T., looked out on his 100 listeners in dresses or shirts and ties. Yes, he said, the real issue is this: "What piece of the action over which you now have control are you willing to give up?" What kind of decisions about our present and future will you let *us* make, and how much resources can you find for *us* to implement those plans?

Did they hear you, Mr. King?

The next day's seminar discussion focussed on two "case histories" of suburban planning efforts: How the town of Lincoln, Mass., an extraordinarily beautiful and wealthy village of 5,000 people just 15 miles west of Boston, has devised for itself an elaborate, and clearly excellent, 10-year plan to assure that its present qualities be preserved and made available to all who can gain access, including some who will live in low- and moderate-income housing. And how Arthur Barnes, when he retired as Vice President of Polaroid Corp., became the chief proponent of six "integral cities" for eastern Massachusetts which are planned to capitalize upon the best resources in each area, developing them rationally for quality and self-sufficiency.

An observer could only conclude that the "limousine liberal" wears coats of many colors, and dies hard.—*J.I.M.*

The Profit Potential of Housing Factories

M.I.T.'s involvement in low-income housing (the Institute is currently developing 1,000 units in Cambridge) has led to a careful inquiry into the advantages of "factory" methods. The result is a 480-page report which examines the housing problems of the whole of New England, surveys the available building systems, describes a new one, and concludes that an investment of $4,500,000 could yield a pretax return of 36 per cent.

Antony Herrey of M.I.T.'s Real Estate Office and Professor William Litle of the Civil Engineering Department, in their *Industrialized Housing Feasibility Study*, classify existing multiple-unit housing systems into four basic types, depending on whether the components coming from the factory are posts and beams, panels, three-dimensional "boxes," or some combination. They find that the greatest advantages, both in cost and construction time, could be obtained with a lightweight box system, and they propose one that would work as follows:

☐ A limited number of different steel-framed modules—one story high, about 12 ft. wide and 50 ft. long—are designed to permit variations in interior layout, equipment, and finish.

☐ As much work as possible is done in the factory. At the end of the assembly line the modules, "containing all final components and finishes," are placed on a flat-bed trailer.

☐ Concurrently with manufacture, the site is prepared to receive the modules —utilities, foundations, site work and landscaping are all made ready.

☐ The trailer is pulled to the site, possibly hundreds of miles from the factory. (In contrast to the conventional wisdom, the authors find that distance is not an economically important factor.)

☐ A crane sets each module on to the foundation, or on to the module below, after which site crews have only to secure it, connect utilities and perform a final touch-up.

As compared with conventional building methods, total cost could be reduced by nearly 25 per cent, and time from start of design to finish of construction could be cut in half (the report includes a critical-path schedule). Construction savings accrue from the higher efficiency of factory labor, differences in wage rates, and, in general, tighter control of costs. Nonconstruction costs also decrease, mostly because speedy construction cuts down on interest payments, taxes, insurance and inflation.

But there is no economy in trying to build 50 or 100 houses a year in a converted warehouse. The M.I.T. study calculated that the economic breakeven is at 600 to 700 units annually, and the authors note with optimism that "the existing multi-unit housing market in the Northeast is 100 times larger than that needed to sustain an operating organization of feasible size." There remains the issue of a market aggregator; perhaps only planning at the state or federal level can collect the needed market.

But, given an adequate, reliable, and steady flow of orders, a firm could enter the field with a good chance of success. Such a firm should be "one integrated organization which will combine the traditional functions of the manufacturer with those of the real estate developer so as to design, develop, finance, manufacture, market, sell, deliver, erect, and complete buildings. . . ."—*Michael Chiusano*

Housing: Where the Money Does Not Go

Perhaps as much as half of the federal subsidy funds intended to help low-income families to find adequate housing never reach the residents they were supposed to benefit. Furthermore, the conditions of aid are such that what federal benefits finally filter down serve to reduce rather than enhance such families' freedom in solving their housing needs.

The beneficiaries are the intermediary bodies who are specified in federal programs to disperse funds and operate housing programs—local government, local housing authorities, housing sponsors, urban renewal agencies, and Federal Housing Authority offices.

These were the conclusions of a research team in the M.I.T. Department of Urban Studies and Planning who studied federal housing subsidies for the Subcommittee on Housing of the House Committee on Banking and Currency. The study results were originally given to the Subcommittee in June, 1971 by Bernard J. Frieden, Director of the Joint Center for Urban Studies of M.I.T. and Harvard; the Center published the results, with background papers, early this spring.

After analyzing federal housing programs in Boston, the research team concluded that "between one-fourth and one-half of the total federal subsidy does not reach the residents—but goes for federal and local administrative expenses and for tax benefits to investors."

The intermediary agencies are designed to offer safeguards and services to the federal government, investors, and low-income residents. They do. But in the process they have the effect of siphoning off a significant share of subsidy funds, and they also serve to "restrict the choices open to client families in several unfortunate ways," writes Dr. Frieden, who is Professor of City Planning at M.I.T. Among these he lists:

☐ Consumers can obtain federal housing subsidies only in communities where intermediaries are active; help is simply not available elsewhere. There is in fact "little correspondence between the number of low-income families in a region and the volume of federally subsidized housing there," Professor Frieden writes.

☐ Requirements for local government approval have the effect of putting low-income housing into the political arena, where ballot-box vetos are common.

☐ Even within a community, intermediaries often serve to limit the choices available to recipients. Only certain buildings are approved, or projects are available only in certain parts of a city, whereas for many residents (not very surprisingly) "choice of neighborhood is even more important than the condition of the housing," writes Professor Frieden.

☐ Intermediaries sometimes set unnecessarily high standards for housing and so raise its cost. Professor Frieden cites a study of Philadelphia housing: Older row houses in "move-in" (adequate) condition could be bought for $2,000 to $5,000; but the Philadelphia Housing Authority insisted on completing renovations irrespective of specific needs—and the price rose to $12,000.

☐ Intermediaries are responsible for management and maintenance. The tenant, whether or not he likes or wants these services, is trapped: he cannot take his subsidy to the housing of his choice, for it is the building that is "assisted," not the person.

To resolve these problems, Professor Frieden and his associates—Victor Bach, Lisa Peattie, Martin Rein, Arthur Solomon, David Stern, and James Wallace, all of the M.I.T. Department of Urban Studies and Planning—propose a system of housing "allowances" paid directly to tenants. These should be calculated on the basis of income and family characteristics; though there should of course be local government agencies to maintain certain minimum standards, families would be "on their own" to solve their housing problems effectively. The result would be greater freedom for tenants—and a housing market responsive to supply-and-demand economics.—*J.I.M.*

OCEANS

A New Law for The High Seas

Traditional international law of the sea has permitted four basic freedoms—of navigation, fishing, submarine travel, and overflight. These traditional freedoms have meant that any nation could do whatever it liked on the open sea outside of territorial limits. They have been so broad because we have seen no danger in the lack of regulation: the oceans seemed too vast and their resources too rich for man to deplete. There seemed enough for everybody.

But now these assumptions seem false, and "coastal states have virtually no option but to extend their own national jurisdiction whenever they feel their own interests are endangered;" so Arvid Pardo, Malta's Minister for Ocean Affairs at the United Nations, said when he gave the second J. Seward Johnson Lecture on Marine Policy at the Woods Hole Oceanographic Institution last spring.

In response to the principle that every person on earth has a right to share in the use and resources of the oceans, Ambassador Pardo has proposed an international authority, with power surpassing that of the U.N., to control activity in and on the high seas. His administration would rely for its authority on the reasonableness of all nations and their desire for order: without that, he believes, no force will work. (Power must be apportioned differently from the way it is in the U.N., he added, if the new authority is to carry any weight.)

The administration would concern itself with "the credible maintenance of law and order" on the oceans, the safeguarding of the natural state and quality of the marine environment, the promotion of research and the dissemination of scientific knowledge, the promotion of the development of technology for the penetration and use of the oceans, the coordination of the uses of the oceans by different nations, and the orderly management of ocean space beyond national jurisdictions.

It would have complete powers to license vessels for research, fishing, mining, and other uses. Its sanctions in case of disobedience would be revocation of a nation's licenses. The administration would need no peace-keeping forces, the ambassador said; its authority to revoke licenses would suffice. If a nation continued to use the oceans without its licenses, he feels, public opinion would force it to cease and obey. How about a world ocean police force as a last resort? No, the oceans simply cannot be treated that way; they are too large. Mr. Pardo hopes and believes the advantages of having an international order for ocean space would be so obvious and so desirable that nations would willingly comply.

Mr. Pardo's international ocean authority would include all nations, divided into three groups: coastal nations with populations of over 90 million; coastal nations with fewer people which met certain qualifications regarding, for example, size of fishing fleet; and others. A vote from a nation in the first group would weigh more than a vote from one in the second, and so forth. Funds from licensing commercial enterprises and from royalties, perhaps many millions of dollars, would be distributed among all nations according to a formula favoring less developed nations.

Does he think such an order will come to be? The ambassador is a practical and only guardedly optimistic man. If the nations of the world want a new law of the seas, he says, they will make one work. If not, they will not. They might not recognize that order is essential.—*J.K.*

Are Sirens Worth Their Noise?

An ambulance flashes through the hot night, its siren wailing and tires screeching as it dodges through the thinning traffic.

Three flights up, a tenement dweller turns fitfully in his bed, disturbed again on the threshold of sleep.

A block ahead, a tired middle-aged business man is driving home late in his large air-conditioned car. His favorite music oozes from the stereo.

Inside the ambulance is a coronary patient; the driver knows that a few moments time might make the difference between life and death. His fast-moving view is rhythmically splashed with red; the siren is deafening—90 to 95 dB. at the driver's ear.

As the business man enters the intersection, he hears the siren for the first time. He looks around—but now the fast-moving ambulance is only 100 feet away. He reacts with the wrong move.

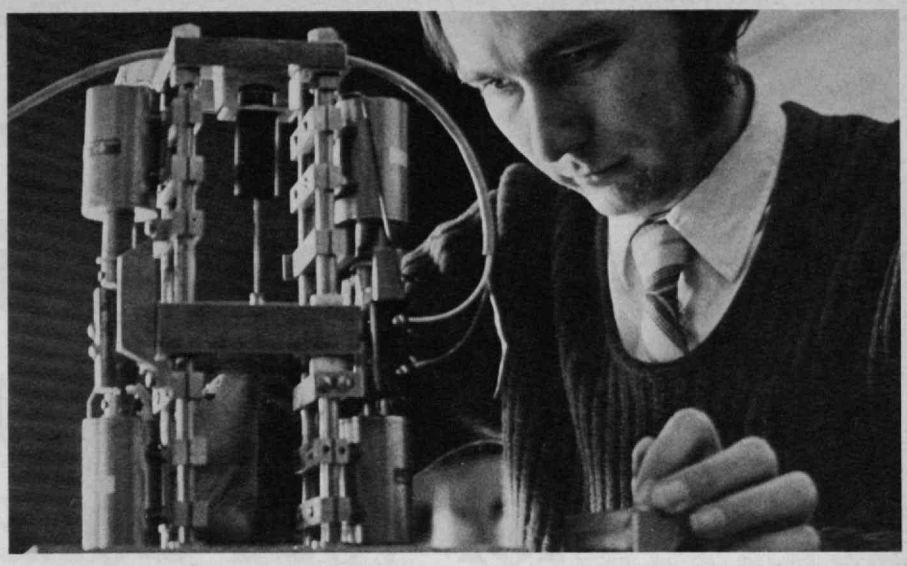
This scenario was offered by Messrs. K. M. Eldred and B. H. Sharp of Wyle Laboratories at a symposium on noise at last May's International Conference on Transportation and the Environment. The story's moral is that the siren, in this and many cases, "has not succeeded in achieving adequate warning system effectiveness . . ., although it has succeeded in increasing the noise levels in our cities."

The problem can be reduced to arithmetic. At a distance of 100 feet, emergency vehicle sirens produce sound levels of 92 to 112 dB.; air horns at the same distance range between 82 and 103 dB., and car and motorcycle horns range between 45 and 95 dB.

The great problem is with automobiles: "Recent attempts by the motor vehicle manufacturers to reduce the internal noise levels in their products have been very successful." A typical modern automobile, the authors found, attenuates outside sounds by about 25 dB. with the windows closed.

But the car itself makes noise. Interior levels in typical cars with all the windows closed range from 65 to 73 dB. at 30 mi./h., from 68 to 77 dB. at 50 mi./h., and from 72 to 82 dB. at 70 mi./h. At the higher speeds, the wind noise from an open window adds 10 to 15 dB., making it *no* easier to hear outside sounds when a window is open. A siren that makes 95 dB. will be only slightly louder than background inside a nearby car.

"Clearly," Messrs. Eldred and Sharp conclude, "the solution is to find a better approach for signalling to the driver of a vehicle that danger from another vehicle is imminent." They propose some system that would *not* depend on sound.—*O. Reid Ashe*



Dr. Richard C. Arnold, at Argonne National Laboratory, has proposed and tested a fundamentally new medium of communication—a beam of muon particles. The photograph shows his "shutter-like" modulation system: by moving a brass energy-absorber into and out of the beam, he transmitted, in his initial trial, a repeated V-signal in Morse.

A New Medium

For the transmission of detailed messages without wires or other solid intermediaries, mankind still relies upon just two media: acoustic and electromagnetic radiation (including the older optical systems among the latter). Richard C. Arnold, at Argonne National Laboratory, proposes a new one—muon particles (*Science*, Vol. 177, pp. 163-164).

The muon is a charged particle, about 200 times as massive as the electron but resembling it in other respects. Because of its greater mass, it is deflected far less by a given electrical or magnetic force. Most of the currently known fundamental particles are of course still heavier, by factors of ten or more, but the muon differs from them in being unaffected by the "strong" (or nuclear) forces. For these two reasons it has great penetrating power. The muon was first observed in 1936, in cosmic radiation.

To generate intense beams of high-energy muons is now relatively easy; they are the decay products of a slightly heavier particle, the pi-meson, which can in turn be made by placing an appropriate target in the beam from a proton-synchrotron. It is estimated that a special-purpose 100-GeV synchrotron could be built for $10 million. Such a machine would provide muons with an energy of 50 GeV. At this energy, Dr. Arnold notes, muons have the interesting property of being deflected by the earth's magnetic field just enough to follow the curvature of the surface (in the special case, admittedly, of transmission along the magnetic equator); and their effective range would be 1000 km., if it assumed that the beam strength can be allowed to decay in transit by a factor of ten.

Dr. Arnold thinks that the information-coding element could be the individual muon, and that muons could be detected with a time accuracy of 10^{-9} sec.; thus, a beam with an intensity of 10^9 muons/sec. would have a bandwidth of 1000 MHz. He points out that a microwave relay system also costs about $10 million per 1000 km.

This April, Dr. Arnold used the 12-GeV proton synchrotron at Argonne in a first demonstration of the new medium. The muon beam "passed through 1.5 meters of concrete shielding and other fairly massive obstacles," and was successfully detected 150 meters away by a pair of 30-cm.-square scintillation counters. He transmitted Morse code, by the simple means of moving a block of brass into and out of the beam. (The brass absorbs a small amount of energy, temporarily preventing the beam from being accurately focussed by the magnetic lenses used.)

In a final paragraph, Dr. Arnold suggests that a later step will be to use neutrinos, whose unique penetrating power is such that "line-of-sight" communication would be possible "for example, between the National Accelerator Laboratory (Batavia, Illinois) and Australia." But the design of a neutrino-receiver remains something of a problem.—*F.W.*

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Prizes for Newcomers

Puzzle Corner:
Allan J. Gottlieb

Hi. Alice and I are back East and ready for the academic year. I am teaching at the State College in North Adams, Mass. (01247), and all mail should be sent to me at the Department of Mathemaatics here.

This summer we drove fairly slowly across the country, stopping at many national parks. A year ago I had never been to one; now I've seen seven, and I heartily recommend all of them: Haleakala, Volcanos, Yosemite, Sequoia, Yellowstone, Grand Teton, and Glacier. Having lived in New York City and Boston all my life—until two years ago—I had a very distorted view of this sparsely populated country of ours. Although the constant travelling was tiring, the trip was educational and quite rewarding.

The only regrets I have about our California stay are having to leave another set of friends behind. Let me therefore dedicate this column to my colleagues at the University of California in Santa Cruz and to our neighbors Eric and Gail Heit and Bob and Diane Jackson. We miss you all.

Before starting a new year's columns, let me review the "rules" for Puzzle Corner: every month we publish five problems and several "speed problems," selected from those suggested by readers. The first selection each month will be either a bridge or a chess problem. We ask readers to send us their solutions to each problem, and three issues later we select for publication one of the answers—if any—to each problem, and we publish the names of other readers submitting correct answers. Answers received too late or additional comments of special interest are published as space permits under "Better Late Than Never." Except under unusual circumstances, no answers or discussions are published concerning "speed problems." And I cannot respond to readers' answers and queries except through the column itself.

You've Never Written Me?

As you see, readers' participation is not only welcome; it's essential to the success of "Puzzle Corner." We're grateful to the many who have contributed in the six years since "Puzzle Corner" began in *Technology Review*; but the Editors tell us that lots of people comment on the column but say they've never submitted answers or problems. So here is something special, just in time for Christmas, 1972: *Technology Review* will send a valuable prize to each reader who writes me for the first time ever in response to this installment of "Puzzle Corner" by December 15, the deadline for the column in which answers to these problems will appear (February, 1973, issue). Note on your letter that you've never before corresponded with "Puzzle Corner," and the prize will reach you just in time for Christmas.

Now on with "Puzzle Corner" 's seventh year in *Technology Review*.

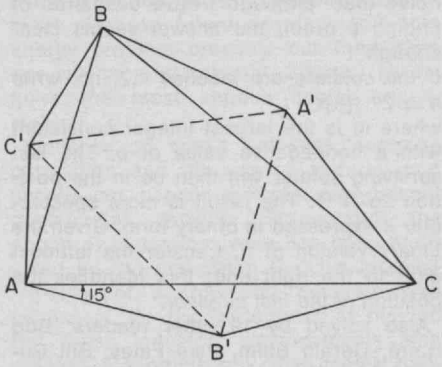
Problems

This month we begin with a chess problem from Douglas Goodman (by the way, my supply of chess problems for future issues is critically low):

O/N1 Suppose your arrogant opponent, instead of just giving you the first move, let's you set up your pieces in any positions you want, as long as you keep them on your half of the board. He then reserves to himself the privilege of the first move (his pieces begin in the normal position). What is the best arrangement in order for you to force mate as quickly as possible?

A geometry problem from Frank Rubin:

O/N2 On the sides of a triangle ABC are erected three isosceles triangles with base angles of 15° and vertices A′, B′, and C′ external to ABC. Prove that triangle A′B′C′ is equilateral.



Here is a geography problem from Karel Jan Bossart which I particularly enjoy:

O/N3 We cover the globe with a set of geodetic points in such a way that the distances from any point to three of its closest neighbors are the same. If we further stipulate that one of the points lies in Cambridge, Mass., and that another one lies due north of the first one, (1) what is the location of the second point? and (2) how many points fall in the U.S.? Assume the earth to be a perfect sphere.

A. Porter submitted the following combinatorial problem; he writes that he is "almost certain" that the answer to his final question is negative, but he is "stumped trying to formulate a general proof":

O/N4 Given a set of N elements arranged in a particular lineal order, rearrange the elements in a new lineal order to satisfy the following two conditions: (1) no element to be in its original position; and (2) no two elements which were originally consecutive to be consecutive (they may still be adjacent as long as their order is reversed). It may be seen that this can easily be done as long as N is even. As an example, consider the case $N = 4$ and the set defined as {1,2,3,4} arranged thus:

1 2 3 4

Rearranging the set thus:

4 3 2 1

satisfies both conditions. Can this be accomplished if N is odd? If not, prove.

This problem, from Harry Zaremba, perhaps should have appeared prior to the 1972 winter meeting of the American Mathematical Society; that meeting was in Las Vegas. Mr. Zaremba himself writes that it "perhaps may discourage some current or would-be gamblers from rattling the 'bones' ":

O/N5 In four tosses of a pair of dice, what are the odds against making a seven on the first throw and the point six on the second and fourth tosses without losing one's turn to roll?

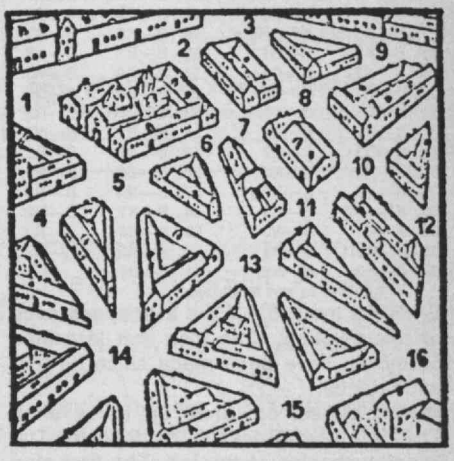
Speed Department

This well known fallacy may interest some new puzzle enthusiasts. It was submitted by John Bobbitt:

O/NSD1 Given two concentric circles of radius a and b, $a > b$. The larger circle is rolled along a straight line one complete revolution, without slipping; thus it travels $2\pi a$. Meanwhile, the smaller circle has rolled also $2\pi a$ without slipping. Thus its circumference is also $2\pi a$. What's wrong?

Russell A. Nahigan sends this problem which originally appeared in *Boys' Life*:

O/NSD2 Can you tell at what intersections (see chart) four policemen must be posted so that they can observe every street?



A Correction

For those who may still be working on problems published in June, please note: On problem **JN3**, add the requirement $-\frac{1}{2} < x < 1$.

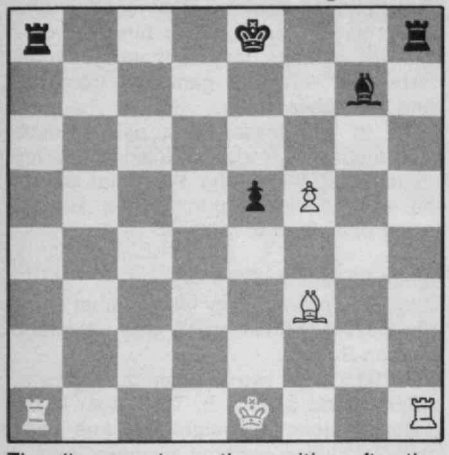
Solutions

Here are solutions for problems published in *Technology Review* for May, 1972.

M1 In the laws governing the game of chess, provision is made for the claim of a draw under a variety of circumstances. In particular, Law 12 states (in part), "The game is drawn . . . 3. Upon demand by one of the players when the same position appears three times, provided that the same player has the move after each of the three appearances of the same posilion on the chess board. The position is considered the same if men of the same kind and color occupy the same squares, and the possible moves of all the men are unchanged. . . ." I have found a position reachable by legal play which can occur 21 times without either player being able to de-

mand a draw; can any of your *Technology Review* readers do better?

Only Harry Nelson, the proposer, tackled this one. Here is his amazing solution:



The diagram shows the position after the 18th moves, and in this list of later moves we italicize each which results in a repeated position:

	White	Black		White	Black
18.	—	P—K4	40.	B—N4	B—R3
19.	B—K2	B—R3	41.	B—K2	B—N2
20.	B—B3	*B—N2**	42.	*B—B3*	B—R3
21.	B—K2	B—R3	43.	B—K2	B—N2
22.	B—B3	*B—N2*	44.	*B—B3*	QR—N1
23.	B—N4	B—R3	45.	B—K2	R—R1
24.	B—K2	B—N2	46.	*B—B3*	B—R3
25.	*B—B3*	B—R3	47.	B—K2	B—N2
26.	B—K2	B—N2	48.	*B—B3*	B—B1
27.	*B—B3*	KR—R2	49.	B—K2	B—R3
28.	B—K2	R—R1	50.	B—B3	*B—N2*
29.	*B—B3*	B—R3	51.	B—K2	B—R3
30.	B—K2	B—N2	52.	B—B3	*B—N2*
31.	*B—B3*	B—B1	53.	QR—N1	B—R3
32.	B—K2	B—R3	54.	R—R1	*B—N2*
33.	B—B3	*B—N2*	55.	B—K2	B—R3
34.	B—K2	B—R3	56.	B—B3	*B—N2*
35.	B—B3	*B—N2*	57.	B—N4	B—R3
36.	KR—R2	B—R3	58.	B—K2	B—N2
37.	R—R1	*B—N2*	59.	*B—B3*	B—R3
38.	B—K2	B—R3	60.	B—K2	B—N2
39.	B—B3	*B—N2*	61.	*B—B3*	

* E.P. capture is not available.

B—B3 at move 61. is the 21st appearance of this position. Note also that less than 50 moves have been made since its first appearance.

M2 N soldiers are lined up to be shot. The shooting proceeds as follows: The shooting begins at the left. The first man is skipped, the second man is shot, the third man is skipped, the fourth man is shot, etc., every other man being shot. If a man is not shot, he moves to the end of the line at the right. The last soldier remaining after the shooting is allowed to live. For N = 5, B is shot first, then D, A, and E, and C survives. In general for N soldiers, where should one stand in line if he wishes to live?

Professor Edwin A. Rosenberg notes that variants of this problem, and of **M3** as well, appeared in the same issue of the *Connecticut Mathematics Journal*—amazing. Paul G. N. de Vegvar found a closed-form solution, whereas Robert L. Bishop gave the most popular form of the answer; both solutions are published. First, Mr. de Vegvar's:

Construct the following table, where N is the number of soldiers to be shot, Y the position from the left where one should stand in order to survive, X the N value of the last occurrence of the value 1 in the Y sequence, and P the number of 1's in the Y sequence:

N	Y	X	P	N	Y	X	P
2	1	2	1	10	5	8	3
3	3	2	1	11	7	8	3
4	1	4	2	12	9	8	3
5	3	4	2	13	11	8	3
6	5	4	2	14	13	8	3
7	7	4	2	15	15	8	3
8	1	8	3	16	1	16	4
9	3	8	3	17	3	16	4

For example, let N = 10. We find that Y = 5. The last time a 1 occurred in the Y sequence was N = 8; hence X = 8. The number of 1's that have occurred in the Y sequence by N = 10 is 3; hence P = 3. Note that

$Y = 1 + 2(N - X)$, and (1)

$X = 2^P$. (2)

Also observe that

$P = [\log_2 N]$, (3)

where the brackets indicate the greatest integer less than or equal to $\log_2 N$. By substituting (3) into (2), we get

$X = 2^{[\log_2 N]}$ (4)

Substituting (4) into (1), we obtain

$Y = 1 + 2(N - 2^{[\log_2 N]})$, or

$Y = 1 + 2N - 2^{[\log_2 N]} - 1$

This problem becomes more difficult if the first man is *not* skipped.

In writing his solution, Professor Bishop notes that "although I have despaired of finding a proof, the answer seems clear enough":

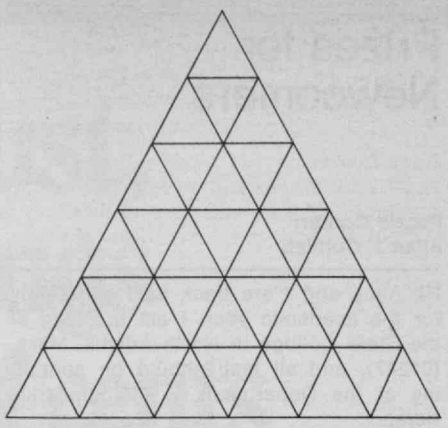
If the soldiers are labelled 1,2,...,n, write

$n = 2^m + p$

where m is the largest integer consistent with a nonnegative value of p. The last surviving soldier will then be in the position 2p + 1. The result is more spectacular if expressed in binary form. Given the binary version of n, transfer the leftmost digit to the right end; this identifies the position of the last survivor.

Also solved by 19 other readers: Bob Baird, Gerald Blum, Paul Fates, Bill Gilbert, Tom Glennon, Winslow H. Hartford, Dick Jenney, Judith Q. Longyear, Ed Nordstrom, David Tomm, R. Robinson Rowe, Don Savage, Henry Seltzer, Lars Sjodahl, Harry Zaremba, Jeff Shadrick and Thomas Woody, and Benjamin Whang and Shou-ling Wang.

M3 The main lobby floor of a new bank building was finished with a mosaic surfacing in which the central feature is a large, contrasting colored triangle patterned from small, equilateral triangles as shown in the illustration above. The floor contractor claimed that it required 10,000 individual units to form the large triangle, and he stated that he could retire comfortably if he had as many dollars as there were triangles of all sizes within



the triangular pattern. How many mosaic units M were along each side of the large triangle, and how many triangles of all sizes, including the large one, are to be found within its bounds?

Many people submitted incorrect answers to this one. L. R. Steffens, however, got it right (one does not wonder, however, that he writes that he moved from the table (below) to the formula "by virtue of some 1922-vintage algebra, a lot of muddling—with repeated comments by my daughter, "You're sick!"—and a hunch that the binomial theorem was involved"):

If the number of small triangles with their bases on a side of the multi-triangle is M, the total number of small triangles is M^2. In the problem given, $M^2 = 10{,}000$, M = 100. The table below pertains; in the last term at the right, the number of triangles with apex down, if M is odd, N = (M − 1)/2; if M is even, N = M/2. Whence, total triangles:

If M is odd: $(2M^3 + 5M^2 + 2M - 1)/8$, and

If M is even: $(2M^3 + 5M^2 + 2M)/8$.

For example, if M = 1, total triangles are $(2 + 5 + 2 - 1)/8 = 1$; if M = 100, total triangles are $(2 \cdot 100^3 + 5 \cdot 100^2 + 2 \cdot 100)/8 = 256{,}275$.

Also solved by Bob Baird, Gerald Blum, Marty McGowan, R. Robinson Rowe, and the proposer, Harry Zaremba.

M4 Prove that if 51 integers are chosen from the 100 integers 1, 2, 3, . . . 100, then among the 51 are two a and b such that a evenly divides b.

Bob Wolf, a colleague of mine at M.I.T. whom I met at Stanford last year, sent in the following elegant solution:

We prove more generally that if n is a positive integer and n + 1 numbers are

Continued on page 71

M	*Total triangles apex up*	*Increment M = i + 1 vs. M = i*	*Total triangles apex down*	*Increment M = i + 1 vs. M = i*	*Total triangles*
		1		0·1	
1	1		0		1
		1 + 2		1·1	
2	4		1		5
		1 + 2 + 3		1·2	
3	10		3		13
		1 + 2 + 3 + 4		2·2	
4	20		7		27
		1 + 2 + . . . + M			
M	$\sum_{i=1}^{i=M} i\,(M + 1 - i)$		$\sum_{i=1}^{i=N} (2M + 1)\,i - 4i^2$		

The Real Cost of War Is Technology

Book Review:
C. Richard Soderberg
Institute Professor and Dean of the School of Engineering, Emeritus, M.I.T.

Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate
M.I.T. Press, 1971, xxiv + 308 pp., $2.95

In 1970, under the chairmanship of Professor Carroll L. Wilson, M.I.T. sponsored a major study of "critical environmental problems," S.C.E.P., in which more than 70 U.S. scientists examined global environmental problems. The present study of man's impact on climate, S.M.I.C., also sponsored by M.I.T. and chaired by Professor Wilson, is a follow-up to S.C.E.P. It was conducted in Sweden with the Royal Academies of Sciences and Engineering Sciences as hosts. Participating were 30 leaders of science from all over the world.

The report attempts an assessment of: "what we know"; "the major gaps in our knowledge"; and "what must be done to improve our understanding" of six major topics: previous climate changes, man's activities influencing climate, theory and models of climate change, modification of the troposphere and modification of the stratosphere.

The list of participants is impressive and the presentation of problems sober and factual, with specific recommendations on the important topics which urgently require better understanding. In the welter and confusion surrounding the doomsday problems towards which man is headed through his increasing dependence on technology, S.M.I.C. presents a wholesome note of rationality, the more compelling because of its cool assessment of known facts and the great gaps in our present understanding, which can only be filled by patient research.

S.M.I.C. concerns itself with the most complex, also the most fateful, of our environmental problems: the (perhaps irreversible) influences on climate which technology and population increase are generating. Compared to these the more local air and water pollution problems of our centers of population, even though complex, seem relatively much easier to understand.

However, the correction of local problems must be at the core of the entire thrust of conserving the environment. The political and economic difficulties on the local level are serious enough; on the world level they take on appalling proportions. The cosmic perspective is enhanced in the S.M.I.C. study by the look at climate in geological history: for 90 per cent of the 500 million or so years of organic life the earth has been free of polar ice; ice ages are confined to the remaining 10 per cent—we may even now live in an ice age.

Practically all of man's activities—indeed, his very presence on earth—involve dangers to the environment. Overpopulation and agricultural expansion through artificial fertilizers and insecticides are but two examples. Of man's technological activities, however, his use of energy in various forms appears to constitute the greatest threat. It is noteworthy that in the growth of technology the search for energy was central, even in the pre-industrial phase. The industrial revolution in England developed around coal as an energy source; the early developments in steam engines created the rudiments of our industrial system. With the introduction of heat engines, a major source of world-wide pollution of the atmosphere and thermal pollution of water was introduced, along with ever faster use of the world's fuel resources. Nuclear energy by fission could serve to limit atmospheric pollution but only at the cost of added thermal pollution and certain risks of harmful radiation. At least until breeder reactors can be introduced, the fuel resources for nuclear power also continue to be precarious. Only through nuclear energy by fusion, still many decades off, is there hope of wholly new fuel resources and perhaps reduced risks of pollution. Even with the most optimistic assessment of these future developments, the energy problem presents our most serious dilemma, eventually destined to require the most serious social adjustments.

Statistics on man's activities, such as population and the use of material and energy per capita, indicate ever-present geometrical growth. Throughout the epoch of technology man has been motivated by the conviction that his increasing use of energy and minerals was necessary for the betterment of his lot. But these industrial developments also created the philosophy that man's happiness, as well as the survival of the industrial system itself, depended on high consumption and luxuries rather than a modicum of necessities.

Among all of our precious resources, energy occupies a curious position: it can neither be destroyed or recycled; "use" of energy is synonymous with degradation. Hence, the processing of energy involves an inexorable flow of heat into the environment, coupled with discharge of debris into the atmosphere. S.M.I.C. estimates that the world average heat rejection to the environment from our use of energy might total 1 per cent of the solar radiation in 40 years—seemingly insignificant until put beside the key role of solar radiation in influencing the climate. Certain industrial regions have heat rejections many times greater.

Technology has without a doubt enabled man to realize his dreams of material well being, and also of freedom and democracy, but seemingly at the price of eventual doom. We have been content to leave decisions on social choices to the more or less automatic workings of the economic system. Perhaps the most fateful decisions in the chain of history, which led to the present situation, were made in World War II, when technological advances of unprecedented rate and scale were made without the restraint of conscious social choices or even economic considera-

Changing Careers in Science and Engineering
edited by Sanborn C. Brown

This book, which grew out of a "Career Seminar for M.I.T. Alumni" held at M.I.T. in 1971, considers the many problems involved in changing career orientations while preserving the lively and informal style of discussions between speakers and audience. It is directed toward those who feel their careers are threatened by changes in national priorities and funding, as well as toward those who are advancing in their careers but have decided not to stay in the same place for the rest of their lives and are looking for information to help them make their decisions.

Among the authors are Jerome B. Wiesner, Secor D. Browne, Paul A. Samuelson, Charles A. Myers, Lee Grodzins, Paul Penfield, Jr., John Blair, Antony Herry, and Wallace E. Vander Velde.

$7.95

Productivity in the Food Industry:
Problems and Potential
by Gordon F. Bloom
Foreword by Howard Johnson

This timely report appears during a period when rising food prices are a subject of public concern and the entire food distribution system is encountering difficulty in handling upward pressures on operating costs.

The book is the first to treat the industry as a systematic whole—or, more exactly, to identify the ways in which it can be made into such a whole, with better couplings at the junctures between manufacturing/processing/transporting/warehousing/retailing. This will require both the application of technological breakthroughs and the breaking down of institutional barriers.

$10.00

What Time Is This Place?
by Kevin Lynch

In 1960, The MIT Press published Kevin Lynch's *The Image of the City*, a widely influential book that explored the differences between one's personal sense of place and "official," "objective" maps. In his new book, *What Time Is This Place?*, he takes a complementary view of the human sense of time, a biological rhythm that follows a different beat from most "official," "objective" timepieces. The center of his interest is on how this innate sense affects the ways we view and change—or conserve, or destroy—our physical environment, especially in the cities. Beyond this, the book reveals that the sense of time and the sense of place are inextricably meshed: Time-place is a continuum of the mind, as fundamental as the space-time that may be the ultimate reality of the material world.

$10.00

prices subject to change

The MIT Press
Massachusetts Institute of Technology
Cambridge, Massachusetts 01242

tions. The nation acted in the conviction that survival was at stake. Such unrestrained technological development may indeed be the most serious consequences of world conflicts.

It is certain, at any rate, that man's salvation from future disasters must involve conscious social choice—sometimes even in conflict with economic objectives. The warding off of inadvertent changes of climate, the subject of the S.M.I.C. study, is one such step. However, not included in the study is an even greater potential danger: the possibility of man's deliberate tampering with the climate—almost certainly in advance of the wisdom to examine critically such undertakings.

The implied message of S.M.I.C. is extreme caution in taking major steps, or even in the continuation of the present trends. What is not sketched out is the extreme difficulties in our society of retrenchment and caution, particularly in the reassessment of economic objectives. Our entire system seems based on boisterous enthusiasm, optimism for the future, and the love of material gain. Retrenchment and retrogression, assuming that they can be achieved at all without the stimulating effect of major catastrophes, will involve depression and despair, unless we can completely reorient our social objectives. This readjustment may be the most difficult process which modern man has faced.

In the field of energy, as an example: Can we effect, first a reduction in the rate of growth, and ultimately a steady state, without a system of autocracy for which we are not prepared? The present momentum of consumption is tremendous, and obvious means for checking consumption, such as much higher taxation of fuel, are not readily achieved.

Perhaps the most important of all is in the field of education—higher education in particular. Looking back on many years in engineering, I doubt that we have fully appreciated the role played in engineering education by enthusiasm, optimism for the future, and belief in the prevailing system. An educational system in an atmosphere of anxiety and doubt will be something quite different. Perhaps we have witnessed fragments of this in the student unrest of the recent years, when the nation attempted a war which lacked social sanction. The scientist and the scholar can achieve a degree of fulfillment even in isolation. The creative application of science, however, requires some degree of sanction of the ultimate social objectives.

Technology will be no less important in future efforts required to save us from disaster. The despair must not lead to the abandonment of the logic of technology—rather a reexamination of its uses. As already indicated, even in the solution to the present dilemma in energy not all the measures need be negative. The possibility of nuclear fusion with wholly new fuel resources, and perhaps milder problems of pollution, has not yet been fully examined. The time scale which can be envisioned for this development, however, leaves us with the present perplexing issues and the threats of disaster essentially unchanged.

It is my conviction that S.M.I.C. has given the proper cue for action: the dispassionate gathering and understanding of relevant facts and an equally dispassionate and courageous marshalling of the social actions needed to avoid disaster.

Library Computers

Book Review:
William N. Locke
Director of Libraries, M.I.T.

Interface: Library Automation with Special Reference to Computing Activity
Edited by C. K. Balmforth and N.S.M. Cox
M.I.T. Press, Cambridge, 1971, ix + 251 pp., $15.00

Collaborative Library Systems Development
Edited by Paul Fasana and Allen Veaner
M.I.T. Press, Cambridge, October, 1971, x + 241 pp., $8.00

These two books, being mostly proceedings of conferences hold two or more years ago, show how fast is the pace of change. The bloom of computer applications to university libraries has faded; all that is left is the pressed flower of history. (Publishers must find a way to shorten to months the years that now pass between the time someone finishes setting down his thoughts in a fast-moving field and the time they reach the public.)

The time lag is particularly damaging to Balmforth and Cox (referred to below as B. & C.). Two years ago British librarians generally did not even have access to computers, while their U.S. counterparts were familiar with many. The gap is going to be very difficult to close, considering that computer use in the U.S. has been doubling every two years. But the gap gives the British an advantage: they can learn from our mistakes while there is still time to avoid them.

B. & C.'s main topics are experimentation on first-generation computers with acquisitions, the British MARC (Machine Readable Cataloging) system, and circulation control. These are experiments financed by grants or carried on in that transitory heaven, free computer time. A recurring difficulty is the interchange of bibliographic information, because British universities have never standardized their cataloging. In this respect the U.S., with the basic Library of Congress MARC system, seems to be ahead, but there are minority views to say that this is outmoded because of its reliance on the straitjacket of traditional bibliographic forms.

What about our mistakes? For some sense of the answer, one may turn to the Fasana and Veaner (F. & V.) volume, a collection from two conferences in 1968 and 1970 reporting progress under National Science Foundation grants for collaborative library systems development. This project succeeded in proving once

again what an earlier Harvard-Yale-Columbia medical library automation project and a number of others have shown—that collaboration in the development of library automation systems doesn't work:

"It was decided that the most valuable contribution that these three institutions could make would be to develop individual systems. . . . Cooperation when it costs nothing is easy, but when it is expensive, as this is, even among men with the best will in the world, cooperation requires of all of its participants the wisdom of Solomon, the patience of Job, and the prophetic powers of blind Tiresias thrown into the bargain."

From one point of view, the collaboration worked very well. By nice grantsmanship each of the three universities received roughly $100 thousand a year for five years and has been able to develop its own system, which would certainly not have been the case if each had come in with a separate proposal.

A Sober Summary

The quality of writing in both these books is high; so is the quality of the thinking. Both books (particularly F. & V.) show a healthy scepticism: "Unless an automation budget can be completely integrated or absorbed into the regular library budget the effort is potentially in serious danger." Again, "It is possible that individual libraries are getting into an awkward position of assuming new responsibilities while at the same time they are reducing their ability to guarantee the quality of their own performance."

Both show much concern with costs in dollars, costs to the consumer, and costs to the library staff. For example, in F. & V.: "If you don't involve the users in the design, you simply cannot have a successful system. . . . For most users of the system I propose that at least the marginal cost associated with his use of the system be charged directly to the user. . . . The investment required to convert basic library operations to a heavily on-line machine system is in the range of $1 or $2 million."

And the real kicker: "We have also learned that to date there have been no demonstrable savings in library operations through automation; that the hardware and the software don't live up to the manufacturer's claims or to our own expectations. We have learned that on-line systems represent a whole new ball game. We know that library automation involves more than just a library staff—it immediately gets us into the political arena with the people that control the purse strings of the university and with those who are in charge of that all important resource, the computer."

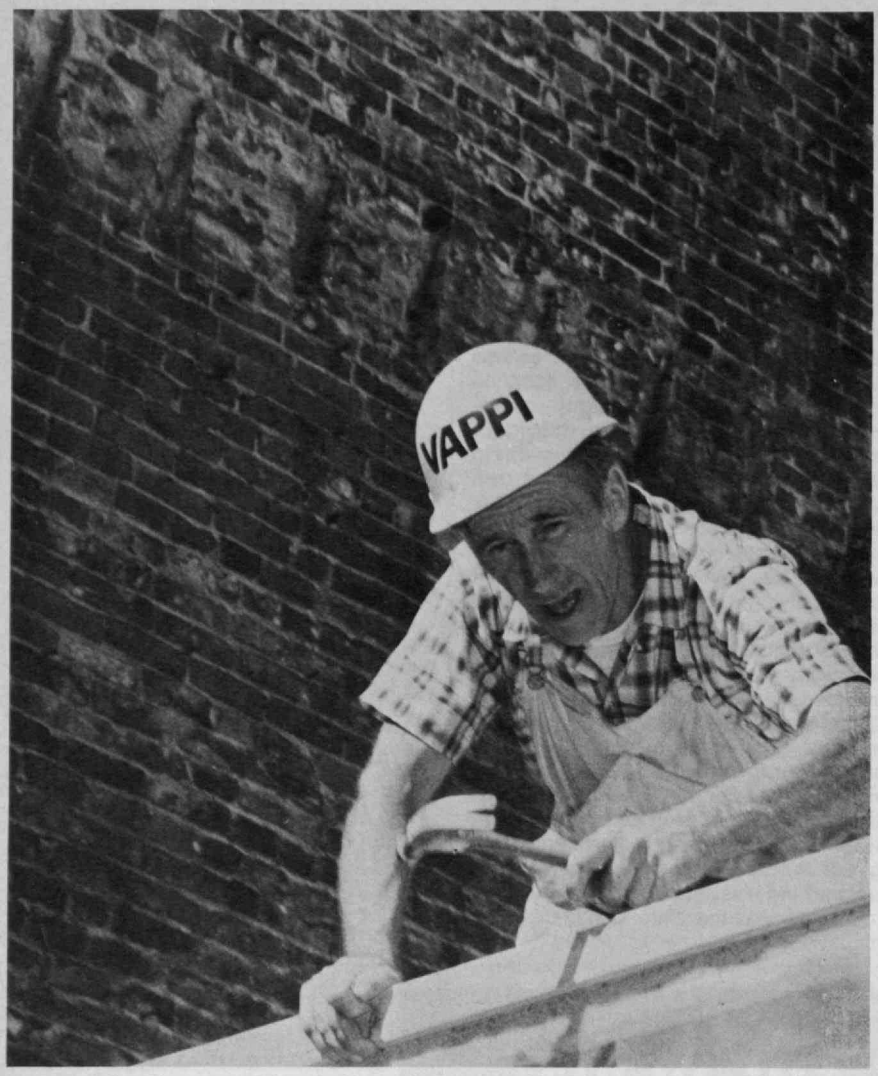
These books are outdated by the exponential growth of computer applications to libraries. Indeed, computers for libraries are at last approaching maturity. In a few universities they are doing financial and bibliographical record-keeping and producing machine-readable catalogs, indexes, and lists. In the spring of 1972 we see the Ohio College Library Center running an on-line real-time computer system which has been operational for almost a year, serving some 80 institutions with bibliographic information and catalog cards.

For a clear picture of the current state of the art, see the authoritative *Libraries and Information Technology—A National System Challenge*, a report of the National Academy of Sciences (Washington, D.C., 1972, xi + 84 pp., $3.25).

Puzzle Corner

Continued from page 68

chosen from {1, 2, . . ., 2n} then there are numbers a, b among the $n + 1$ $\exists$ a/b. (Throughout, when we write a/b we tacitly assume $a \neq b$.) Proof by induction on n. That $n = 1$ is obvious because 1/2. The induction step: say true for $n = k$, we want to show it also true for $k + 1$. So let X be a set of $(k + 1) + 1 = k + 2$ integers from among {1, 2, . . ., $2k + 2$}. Note that if X contains $\geq K + 1$ elements which are $\leq 2k$, then, by the induction hypothesis, we are done. If not, X must contain exactly k elements which are $\leq 2k$ and both of the integers $2k + 1$ and $2k + 2$. If $k + 1 \in X$, we're



done, since $2k + 2 | k + 1$. If $k + 1 \notin X$, proceed as follows: Let $Y = \{m \in X | m \leq 2k\} \cup \{k + 1\}$. Then Y is a set of $k + 1$ distinct integers from $\{1, 2, \ldots, 2k\}$. Therefore, by the induction hypothesis, we can find $a,b \in Y \ni a/b$. Choose such an a and b. If neither $a,b = k + 1$, then $a,b \in X$, so we're done. If either a or $b = k + 1$, note the smaller of a and b cannot be $k + 1$, because any number $c(k + 1)$, where $c > 1$, would be $> 2k$, so cannot be in Y. If the larger number is $k + 1$, then the smaller is a factor of $k + 1$, so it is also a factor of $2k + 2$. Therefore, $2k + 2 |$ the smaller of a,b. And we've seen that a,b and $2k + 2$ are all in X. In all cases, we have shown $\exists\ a,b \in X \ni a/b$. Q.E.D.

Also solved by Bob Baird, Tom Glennon, Winslow H. Hartford, Richard Jenney, Judith Q. Longyear, and R. Robinson Rowe.

M5 Find the rational numbers A, B, and C such that

(1) $A^2 - B^2 = 6$, $B^2 - C^2 = 6$, other than the trivial solution $A = 7/2$, $B = 5/2$, and $C = 1/2$.

(2) $A^2 - B^2 = 29$, $B^2 - C^2 = 29$.

R. Robinson Rowe submitted the following general solution and a detailed solution for which there is simply not space; readers who are interested may receive a copy of the latter from the Editors of the *Review* at Room E19-430, M.I.T., Cambridge, Mass., 02139. Mr. Rowe's result:

The general problem is to solve $A^2 - B^2 = B^2 - C^2 = K$ with A, B, C rational and K integral. The two particular problems are for $K = 6$ and for $K = 29$.

For $K = 6$: $A = 1249/140$; $B = 1201/140$; $C = 1151/140$.

For $K = 29$: $A = 48039601/180180$; $B = 48029801/180180$; $C = 48019999/180180$.

The proposer, Winslow H. Hartford, also solved this problem in its entirety, and partial solutions came from Gerald Blum and Rich Schroeppel.

Better Late Than Never

Solutions to several problems published in Volume 74 of *Technology Review* have been received as follows:

61 Edwin Eigel, Jr.
62 Fereidoun Farassat
67, 68 John Prussing

Letters

Continued from page 8

article in Technology Review *was written we have developed the sensors and logic to a considerable degree. What we are now trying to set up is a multideck vibrating screen with vacuum-plus-blowing over and under it to remove paper and plastic sheets, and a band to remove single items not passing through the screens.*

A Responsibility to Speak

I want to respond to the letters from Messrs. McNutt and Drooker in the July/August issue (*p. 73*)—not by expressing my opinions on U.S. foreign and military policies but on the broad issue of the responsibility of our leaders of intellectual power. If we do not welcome, indeed hope vigorously for, opinions from people who stand at the summit of intellectual competence, then we are in a tragic position. I welcomed the statement from the presidents of the Ivy League and M.I.T. I want and want desperately words of counsel from people who are outside the "vested interests."

Messers. McNutt and Drooker are naive to think that people assume these men were speaking for their respective institutions. The format of leaders of our country speaking as individuals, and giving their positions only for identification, is clearly established.

One of the exciting and hopeful harbingers was the realization on the part of many of our nuclear scientists that having developed the atomic bomb they felt a deep responsibility to enter into the social consequences of this awful force they had produced.

It marked the erosion of the ivory tower separating the cloisters from society.

As a graduate of great M.I.T. I have long hoped for the day when scientists and engineers no longer felt they were on a lofty peak high above the madding crowd.

I salute President Wiesner and all men of his position who recognize that the world needs their judgments. I hope all the men of intellectual leadership will continue to feel a deep responsibility to speak out in the field of human affairs. I am of the opinion that Dr. Wiesner has for long been a "complete citizen." By that I mean a citizen who has a sensitivity and a response to the terrible problems that exist outside his own discipline, with a willingness to speak out.

Let us take hope that he now is no longer in a small minority of his peers. He is now joined with other men of great intellectual stature who are willing to speak their personal opinions regarding the tragedies of our times.

Let us have more counsel, not less, from men and women of high intelligence.

Gregory Smith, '30
Peabody, Mass.

Not the Only "Brass Rat"

The M.I.T. Class of 1974 is wrong when it says the "brass rat" is the only class ring in the world not set with a stone (*see "The Gallery," p. 97 of* Technology Review *for July/August*). Less than 150 miles from M.I.T., in New Haven, Conn., is Albertus Magnus College, whose traditional class ring also contains no stone; instead, it features a seal with silver horn and fleur-de-lis pattern.

Mrs. Leonard P. Fenocketti
Hamden, Conn.

Institute Review

Draper Laboratory: Toward Independence—at "Real Costs"

If present plans materialize, the Charles S. Draper Laboratory will become "an independent nonprofit corporation chartered to carry on research and educational activities in the public interest" on June 30, 1973.

Thus will be fulfilled—but at "real costs" to the Institute—the pledge made by Howard W. Johnson to the faculty on May 20, 1970, while he was President of the Institute, to take M.I.T. as an educational institution out of the Draper Laboratory as a project-oriented research enterprise.

A "major step" toward divestment was achieved this summer when the Naval Materiel Command, representing all federal agencies sponsoring research at M.I.T., agreed to pay indirect expenses up to a rate of 58 per cent of salaries and wages charged to government-sponsored on-campus research at M.I.T. in 1973-74. Off-campus research will be paid at a rate not to exceed 28 per cent. The new overhead rate maximums compare with 52 and 25.5 per cent, respectively, in 1971-72; they will apply only in the first year after divestment—and will be subject to renegotiation thereafter.

But it is expected that these new rates will fail to fully make up to M.I.T. the income which it will lose from Draper Laboratory's research overhead; to do that, it is estimated, would require rates of 60 and 29 per cent, respectively, on campus and off-campus work in 1973-74. Thus the result is to reduce by approximately $2 million the funds which will be available from government research contracts to maintain M.I.T.'s general services—libraries, administration, and buildings—in 1973-74.

This amount, said President Jerome B. Wiesner, who announced the divestment plan this summer, "will have to be met by additional general and unrestricted funds of the Institute" in that year. But he hopes this requirement "will level off at near $1 million annually thereafter."

Thus Dr. Wiesner's announcement contained a sharp warning to the Institute community: "The effort which has taken place to reduce budgets over the past three years will have to be continued and even increased. The next three years will require very careful fiscal management," said Dr. Wiesner, "and will undoubtedly necessitate some additional reduction in services in both academic and support programs."

Though the agreement on overhead charges is called a "major step" toward divestment, four other matters must be resolved before divestment can be considered "a certainty," said Dr. Wiesner. They are:

☐ The Draper Laboratory must successfully negotiate for advance payments on contracts to meet its cash flow requirements.

☐ The Laboratory must find from private sources, as gifts or loans, a minimum of $1 million operating funds "to cushion fluctuations in contract funding" and as a reserve "against unexpected contingencies."

☐ The Laboratory must negotiate with each of its contract sponsors for a management fee to meet whatever operating costs cannot be reimbursed under government contract regulations. Interest on loans for operating funds is an example of such nonreimbursable costs.

☐ The Internal Revenue Service must sanction tax-exempt status for the new corporation.

There is "no reason at present to believe these goals cannot be realized," Dr. Wiesner said in his announcement; and thus he predicted that divestment will in fact be achieved at the end of M.I.T.'s current fiscal year.

He called the present agreement "eminently fair to all parties involved"; said that it is consistent with the conditions set forth by the Executive Committee of the M.I.T. Corporation that "separation must not impair operations of the Draper Laboratory due to inadequate administrative and financial structuring"; and insisted that "there is strong and sincere interest on both sides to continue and enhance the mutually beneficial educational and research interactions between M.I.T. and the Draper Laboratory."

How To Manage a $207 Million Sponsored Research Program

If that problem seems irrelevant when research and development is supposed to be in the midst of a private depression all its own, look again.

For if predictions of the M.I.T. Division of Sponsored Research are as accurate as usual, the Institute's sponsored research volume in the current fiscal year (1972-73) will for the first time exceed $200 million. The current estimate is $207,431,000, compared with $186,235,000 in 1971-72.

That increase—some 11 per cent overall—exceeds the cost of inflation; the salaries and wages component of the total will grow by only 7 per cent.

Nearly $76 million in sponsored research in 1972-73 will be for campus departmental and interdepartmental activities; $71 million will be for Lincoln Laboratory, and $60 million for the Charles S. Draper Laboratory Division, whose divestment is planned for the end of that year (*see above*).

The estimates come from Frank R. Stevens, '46, Director of the M.I.T. Fiscal Planning and Budget Office, and Robert M. Dankese, Assistant Director; Mr. Stevens warns that the forecasts "can be out of line here and there," but he believes they may "be counted on to generate an overall accurate picture of the level of research at M.I.T. in the coming year."

"Conversion" Becomes a Reality

The most striking increase occurs in the forecast of 1972-73 on-campus research, with grants and contracts—not including funds for major sub-contracts—estimated to rise from $65.4 million to $74.1 million, up 13 per cent. This increase includes significant growth in research funds in the Departments of Biology and of Nutrition and Food Science; in the Laboratory for Nuclear Science, which will be operating the new Bates Linear Accelerator for the first time during the current year; and in four of the Institute's other interdepartmental activities—the program in health science and technology, the Bitter National Magnet Laboratory, the Environmental Laboratory, and the Sea Grant Project.

In general, it is noteworthy that the research increases come largely outside areas of traditional emphasis at M.I.T.; this suggests an ability on the part of faculty and staff to identify new needs—and capitalize on new opportunities.

The federal government's share of the on-campus research in 1972-73 will be slightly larger (86 per cent) than in 1971-72 (84 per cent). But within this category are significant changes which

reveal the impact of "conversion": the Department of Defense, having given up most of its support of the Bitter National Magnet Laboratory and the Center for Materials Science and Engineering, will sponsor only 16 per cent of on-campus research in 1972-73, compared with 22 per cent last year; the National Science Foundation, now responsible for major funding for both those activities, will cover 22 per cent of all on-campus sponsored research in 1972-73, up from 15 per cent last year. The Department of Health, Education, and Welfare's share is also up—from 15 to 19 per cent.

Materials Science, Ocean Environment

Estimates from the Fiscal Planning and Budget Office include three major new grants to M.I.T. announced during the summer:

☐ $2,220,000 from the National Science Foundation for continuing operation of the Center for Materials Science and Engineering, part of N.S.F.'s $17 million program to fund materials laboratories at 12 universities. The laboratories were established and formerly funded by the Advanced Research Projects Agency (A.R.P.A.) of the Department of Defense.

☐ Over $48,000 from the New England Regional Commission and the New England River Basins Commission, for research on the environmental and economic consequences of drilling for oil 100 miles off the New England coast. Operating within M.I.T.'s Sea Grant Program, the work is directed by Morris A. Adelman, Professor of Economics; other participants include James A. Fay, S.M.'47, Professor of Mechanical Engineering; Stephen F. Moore, Assistant Professor of Civil Engineering; and John W. Devanney, III, '62, Associate Professor of Ocean Engineering. A report is expected early in 1973.

☐ A $600,000 institutional grant from the National Sea Grant Program, which—supplemented by matching funds from other M.I.T. sources—brings the Institute's Sea Grant program support to more than $1 million for 1972-73. The funds will be used for teaching and research on ocean resources of Massachusetts Bay and the New England region and on studies of ocean utilization and resource development in general, including transportation, marine food sources, mineral resources, and environmental monitoring and control.

Alumni Givers and Their Gifts: 22,067 and $2,793,743 in 1972

Both achievements combined to make the 1972 Alumni Fund a record-breaker. (Its complete report is inserted as a special supplement to this issue of *Technology Review.)*

President Jerome B. Wiesner has written Howard O. McMahon, Ph.D.'41, Alumni Fund Board Chairman, that "every alumnus can take particular pride" in the 1972 Fund's top performance, which "gives us here a greater spur in dealing with the unique technological, academic, and financial complexities of our time."

The Alumni Fund report, said President Wiesner, "eloquently affirms" the impressions which he and Paul E. Gray, '54, Chancellor, formed during their visits with "thousands of alumni" in 1971-72: "the commitment to the continued greatness of the Institute throughout the world-wide M.I.T. community."

Dr. McMahon for himself noted the Institute's "intensive effort to control expenditures and eliminate deficits," which he called "an impressive and effective performance." Together, he said, "alumni generosity and prudent administration will undergird the momentum that M.I.T. must have."

Giving to the M.I.T. Alumni Fund gained 9 per cent between 1970-71 and 1971-72; the 1972 Fund total was 4 per cent above the previous record set in 1969. The rate of Alumni Fund participation in 1972 was 3 per cent higher than ever before—22,067 compared with 21,344 in 1971. And this year's donors were 44 per cent of all alumni solicited, according to Kenneth S. Brock, '48, Director of the Alumni Fund.

Total alumni giving to M.I.T.—including gifts made directly to the Institute as well as through the Alumni Fund—was just over $5 million in 1971-72. Figures for the year's total giving to M.I.T. will be announced by Joseph J. Snyder, '44, Vice President and Treasurer, in his annual report to the Corporation on October 6.

Commenting on the national trends reported by many private universities and on the M.I.T. Alumni Fund results, Mr. Brock said this summer, "All Americans are becoming increasingly aware that the private segment of higher education must have increased private support to survive and grow. It is essential if private universities are to continue as independent centers of intellectual excellence in teaching and research."

Several records-within-a-record were set by the 1972 Alumni Fund. Leadership gifts, for which solicitation was organized in 42 areas in 1972, totalled $1,640,041—up from $1,171,371 in 1971. Participation by alumni of the Graduate School (now 36 per cent) continues the growth recorded every year since separate records were inaugurated in 1965. Two classes—1922 and 1947—set records with their reunion gifts, and a third class—1917—made the first 55-year reunion gift in the Institute's history (*see* Technology Review *for July/August, pp. 92*). Four classes under 20 years graduated achieved participation of 50 per cent or higher; three years ago only one less-than-20-years-out class made such a record.

Leaders in contributing to the 1972 Alumni Fund, excluding the reunion classes, were:

☐ The Class of 1951, with gifts of $154,143.

☐ The Class of 1913, with 71 per cent participation.

☐ Fort Collins, Colo. (among regions with 75 or fewer active alumni), with 78 per cent participation.

☐ Tucson, Ariz. (among regions with 76 to 149 active alumni), with 80 per cent participation.

☐ Acton, Mass. (among regions with 150 or more active alumni), with 73 per cent participation.

How Can Consumer Durables Be Made More Durable?

For an answer to that question, the National Science Foundation has turned to M.I.T. with just over $375,000 for a two-year study. The job will be done jointly in the new Center for Policy Alternatives of the School of Engineering, of which J. Herbert Hollomon, '40, is Director, and the Charles S. Draper Laboratory, where George W. Mayo, Jr., '51, Deputy Associate Director, is co-investigator with Dr. Hollomon.

"The life cycle of a product has three separable stages: its design, production, manufacture, and sale; its use and maintenance; and its disposal as waste," said Dr. Hollomon's proposal to N.S.F. "While there are some figures on each of these phases, there really are no data that interrelate the product's whole life-

cycle and thus give us an accurate idea of the true social cost of many consumer goods."

One figure is known: in 1969 the Department of Commerce estimated that over 70 million service calls were made to maintain some 235 million major appliances in about 60 million households. All this, Dr. Hollomon points out, represents a substantial social cost, and the question is whether it can in fact be reduced.

For example, would the total cost be lower if an appliance were built so that it required less service, or lasted longer, or both—but would cost more in the beginning? Or would it be cheaper and better for a manufacturer to sell a function, such as refrigeration, agreeing to install, maintain, and replace as necessary whatever equipment was needed to keep the family food cold and safe?

Though it sounds like consumerism, Dr. Hollomon told the *Boston Globe* this summer that it won't be "a Nader-type" investigation. "We're not out to gore anybody's ox. We're not out to prove the system is bad. . . . Some people may be frightened by this thing, but there's absolutely no need for it," Dr. Hollomon told the *Globe's* Laurence Collins. (Noting this comment and the fact that the project hopes to enlist representatives of consumer durable firms in an advisory capacity, the editors of the contentious *Environmental Monthly* magazine advised their readers to "please read the final report very, very carefully.")

Phase I of the N.S.F.-sponsored study, now underway, involves a four-month effort to gather data on the performance and cost of consumer durables. In Phase II, five or six specific household durables will be chosen for detailed study. The Center for Policy Alternatives has gathered together an interdisciplinary team of engineers, management experts, and economists, and the Draper Laboratory will provide aerospace technology that "can be converted for more down-to-earth problems," Dr. Hollomon says.

How to Buy, Where to Put the Books? The Librarian Retires

After 16 years in the "pleasant, stimulating, and tiring" job of Director of M.I.T.'s Libraries, William N. Locke this spring asked to be relieved; and during the summer Natalie N. Nicholson, who has been Professor Locke's Associate Director since 1958, was named Acting Director. Beginning this fall, Professor Locke is the Institute's Foreign Study Adviser, and he will work on the problems of interlibrary cooperation in Greater Boston.

Professor Locke was Head of the Department of Foreign Literatures and Linguistics in 1956 when, according to *The Tech,* the Dean of the School of Humanities asked him one day, "Do you use the Libraries?"

"Sure," Professor Locke replied.

"Then you can direct them," said the Dean, shaking that thorny problem out of his palms.

A thorny problem it was. In the period of Professor Locke's direction, the M.I.T. Libraries' budget went from $600,000 to over $3 million, its collections from 600,000 to 1.3 million books. The price of books continued to rise 10 per cent a year, journals 15 per cent. Various libraries in the M.I.T. system continued to run out of space, and the decision to throw away a book turned out to be at least as agonizing—and almost as expensive—as the decision to buy one. Computers were less a panacea than many hoped—and some promised.

Professor Locke first came to M.I.T. in 1945 from teaching assignments at Harvard and Radcliffe; he studied French at Bowdoin and at the Ecole de Preparation des Professeurs de Français a l'Etranger and the Institut de Phonetique in Paris. During his headship of the Department of Modern Languages, as it was then called, Dr. Locke helped initiate research in machine translation, and he is co-author of *Machine Translation of Languages.* Since then he has taken an active interest in evaluating various computer-based systems for handling library materials and information.

Miss Nicholson studied at Simmons College and, under a Carnegie Fellowship, at the Rutgers University School of Library Science. She was Librarian for the School of Engineering at Harvard before coming to M.I.T. as Reference Librarian in 1954. Assuming the role of Acting Director, Miss Nicholson told *Tech Talk* that she especially hoped to achieve "better interaction and understanding between the libraries and their users."

Moving Chairs and Changing Jobs . . .

. . . are part of the summer scene at M.I.T. These new administrative appointments and changes were effective during the summer:

☐ **Paul F. Barrett,** formerly Construction Manager in the Physical Plant Department, is now Superintendent for Engineering and Construction and heads the Department's new Engineering and Construction Division, which will be responsible for all engineering and design on M.I.T. construction and remodelling.

☐ **Allan S. Bufferd,** '59, has returned to the Institute as Associate Director of the Alumni Fund, where his assignment will include coordination of Fund programs for the 20 youngest classes, the Graduate School, the Independent Residence Development Fund, and parents; he will also be general administrator for telethons. Mr. Bufferd received three M.I.T. degrees in metallurgy (S.B., S.M. 1961, and Sc.D. 1965); since completing graduate work he has held several engineering and management positions in the field while also doing technical consulting, teaching graduate courses, and working in professional and trade associations.

☐ **Philip K. Chapman,** Sc.D.'67, has resigned his post as Scientist-Astronaut at the N.A.S.A. Manned Spacecraft Center at Houston to accept a research appointment in the Department of Aeronautics and Astronautics at M.I.T.; he will also work at the Avco Everett Research Laboratory. Before joining the N.A.S.A. group, Dr. Chapman was Staff Physicist in the M.I.T. Experimental Astronomy Laboratory.

W. N. Locke
Foreign Study Adviser

N. N. Nicholson
Acting Librarian

☐ After five years as its Director, **Jack W. Christensen,** '58, has left the Industrial Liaison Office to join the M.I.T. Development Foundation, Inc., as Secretary; he will have general management responsibilities for the Foundation, whose purpose is to speed the results of academic research into profitable industrial use (*see* Technology Review *for June, p. 67*). Mr. Christensen studied electrical engineering at M.I.T. and returned to the Institute's Industrial Liaison Office in 1967 following various Strategic Air Command assignments as an officer in the U.S. Air Force.

☐ **Miles P. Cowen,** formerly Superintendent of Building Services, has been named Assistant Director of Physical Plant for Special Services; he will coordinate existing services for special events and develop new projects as demands require.

☐ **Theodore M. Doan, Jr.,** formerly Mr. Cowen's assistant, has been advanced to Manager of Building Services with primary responsibility for the Physical Plant Department's custodial, watchman, and mail services.

☐ **Michael Feirtag,** '72, has joined *Technology Review* as Assistant Editor. While studying in the Institute's general physical sciences curriculum as an undergraduate, Mr. Feirtag was associated with *The Tech;* and just before graduating he received the William L. Stewart, Jr., Award for extracurricular activities and Robert A. Boit Prize in writing.

☐ **Henry J. Leonard,** who has been Personnel Officer for the Physical Plant Department, is now Superintendent for Support Services, coordinating building services and grounds maintenance activities of the Department.

☐ **Walter L. Milne,** Assistant to the Chairman of the Corporation, has now been given the additional title of Special Assistant to the President for Urban Relations; the new designation recognizes Mr. Milne's wide responsibilities in M.I.T.'s urban and community relations, for which he supplies substantial direction. This involves M.I.T. administrative policies in relation to the surrounding communities and their use of M.I.T. resources in helping to resolve many community problems. Mr. Milne is a Director of the Cambridge Model Cities Program, the Cambridge Economic Opportunity Committee, the Reliance Cooperative Bank, the Cambridge and Cambridgeport Savings Banks, the Boston Urban Observatory, the Northgate Community

A. S. Bufferd, '59
Alumni Fund

J. Christensen, '58
Development Foundation

Walter L. Milne
Urban Relations

P. Richardson, '48
Admissions

C. Sheehan, S.M.'67
Industrial Liaison

Corp., and the Minuteman Council of the Boy Scouts of America. He is President of the East End Union; and he is a member of the Cambridge Chamber of Commerce, the Cambridge Civic Unity Committee, the Cambridge Rotary Club, the Cambridge Committee on the Bicentennial, and the Cambridge Occupational Education Advisory Committee. Mr. Milne first came to M.I.T. in 1951 to join the News Office, and he has since held assignments in the Educational Council and the Public Relations Office.

☐ Formerly Manager of Kresge Auditorium, **Conor Moran**'s responsibilities has have now been extended to include as well the Chapel and Student Center; as a member of the Physical Plant Department, he will have day-to-day supervision of all three West Campus student facilities.

☐ **Natalie N. Nicholson,** Associate Director of Libraries, has been named Acting Director upon the resignation of William N. Locke (*see above*).

☐ **Joseph M. Patten,** formerly Associate Director of Fiscal Planning, has joined the Institute's Information Processing Services to direct its Office of Administrative Information Systems through which information services are provided for financial and administrative offices and for these functions within departments and laboratories. Mr. Patten first joined the M.I.T. Comptroller's office in 1958 and for two years was Associate Director of Teaching Programs in the Sloan School of Management.

☐ Upon Roland B. Greeley's retirement, **Peter H. Richardson,** '48 (*see below*), has been named to succeed him as Director of Admissions; Mr. Richardson has been Associate Director since coming to M.I.T. from a career in secondary school science teaching and administration in 1964. In reporting the appointment to the Institute community and to Educational Counselors, Paul E. Gray, '54, Chancellor of M.I.T., noted that Mr. Richardson has "a sympathetic understanding of the dilemmas of choice facing the young person considering college or university education," and he emphasized Mr. Richardson's "insight into the nature of the educational experience at M.I.T." Mr. Richardson studied general engineering at M.I.T., and he holds a master's degree in guidance and psychology from the University of Connecticut (1957).

☐ Carola B. Eisenberg, newly appointed Dean for Student Affairs, has named **Alice M. Seelinger** to be Administrative Officer for the Office of the Dean. Miss Seelinger is no stranger to the assignment, having been secretary to Kenneth R. Wadleigh, '43, when he served as Dean of Student Affairs; more recently she has been Administrative Assistant to Mr. Wadleigh as Vice President of the Institute.

☐ **Charles J. Sheehan,** S.M.'67, a member of the Industrial Liaison Office since 1969, has been named to succeed Jack W. Christensen, '58 (see above), as its Director. A graduate of Northeastern University, Mr. Sheehan held technical assignments at Esso Research and Engineering Co. before returning to M.I.T. for his first I.L.O. position. Now he will direct the program organized to keep a select group of major research-based corporations in touch with basic research in science, engineering, and management at the Institute. He hopes to extend the program to companies based in "technologies aimed at problems of wide public concern"—such as transportation.

Admissions: No Template

As Peter H. Richardson, '48, moves about the corridors of M.I.T., he is not overcome by a sense of power to pick a freshman class and so determine the destiny of the Institute. "The thing that makes M.I.T. is not the Admissions Office," he says. "What really attracts students is the faculty. In a very fundamental sense, we don't do anything."

Mr. Richardson, who has just become M.I.T.'s Director of Admissions, agrees that his office's work can be described as providing the faculty with high quality intellectual raw material. But this cannot be done by having the faculty give him a template, for there is not—nor should there be—any single "best qualified" M.I.T. student. There is strength only in variety, says Mr. Richardson, and "our best input comes from having the faculty directly involved in the admissions process."

This year's class of 1,057 freshmen was chosen from 3,665 applicants—of whom more than half were invited to attend the Institute. The "yield"—the proportion of those admitted who in fact register as freshmen—is about 56 per cent, not significantly different from previous years despite increased cost and decreased financial aid.

Mr. Richardson's concern as he assumes his new responsibilities is as much with "changes taking place outside M.I.T." as with the rising cost of an education. "There's no question," he says, "that the number of students who think that mathematics, science, and engineering are automatic keys to the solution of the world's problems has diminished. What we need is a group of kids who recognize the validity of the analytical tools.

"Unfortunately, now that some of the glamour has worn off, we've got to make a much stronger case. We're going to have to work a lot harder in the next five years to get a class of the quality that we've had for the last ten years."

William J. Hecht, '61, Associate Director of Admissions who is in charge of the Educational Council, thinks the answer will have to do with better public relations. If the public's knowledge of M.I.T. is accurate and extensive, those who seek an education here will be largely those who would most benefit from it. So, he says, the problem of admissions becomes one of understanding the myths of M.I.T. and how those myths affect this "self-selection" process.

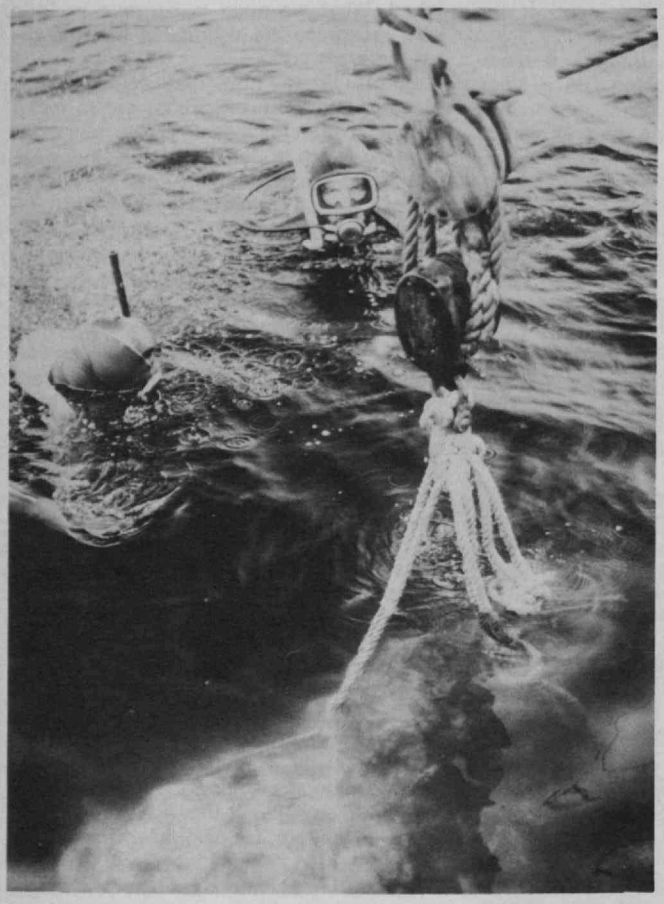
Mr. Hecht offers two troublesome myths:

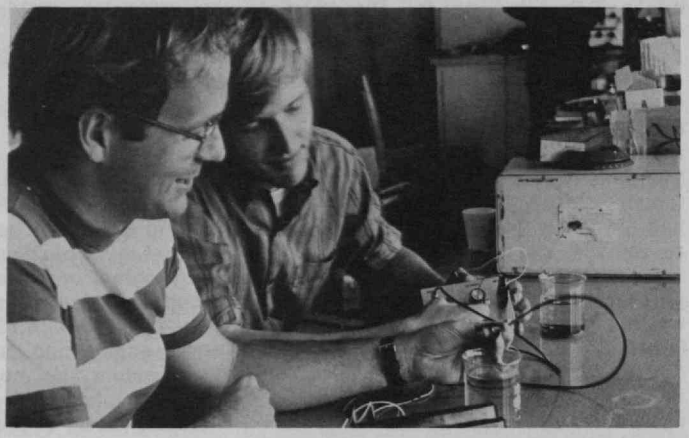
☐ The myth that "M.I.T. to the professions is something like Parris Island is to the Marines," with its attendant image of a student persevering only through his own raw guts.

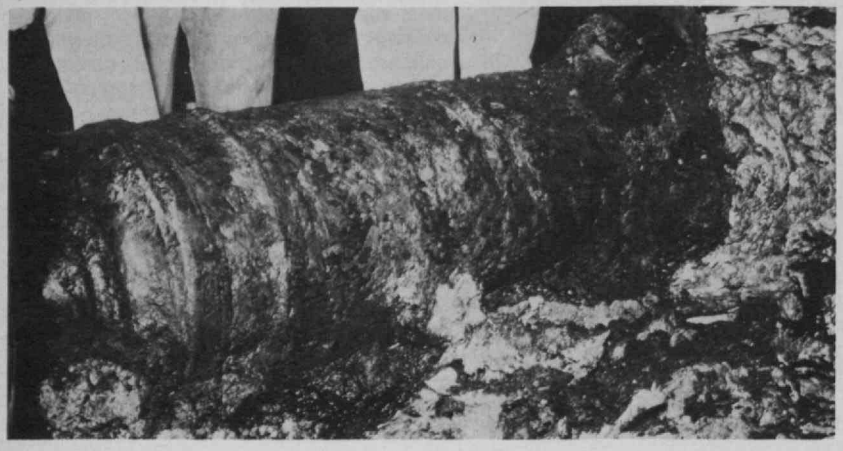
☐ The myth that the M.I.T. student graduates unable to build anything or conduct experiments, because his education has been theoretical and unapplied. Yet the seemingly nebulous studies often have fortuitous results, according to Mr. Hecht, among them the early ability of M.I.T. engineers to design with transistors.

The M.I.T. education seems to change every four to six years, and the freshman class seems different—in an undefinable way—every two or three years, exacerbating the problem of communicating to the public something of the changing nature of the Institute.

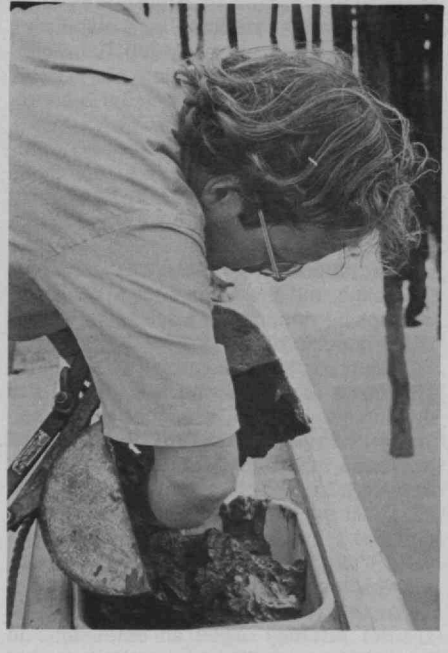
"There is no one impression of the institution," Mr. Hecht says. For good reason: it is many different things to many people—including its alumni; and some 600 of them, as members of the Educational Council, actually conduct 85 per cent of the interviews with prospective freshmen. Mr. Hecht's question—"How can M.I.T. speak with a lot of different voices through a lot of different people?"—has no easy answer.







Willard F. Searle, Jr., N.E.'52, Lecturer in Ocean Engineering, called it (top) "the best diving boat" he ever worked from. It was Professor Damon E. Cummings' ('59) lobsterman, outfitted as an oceanographic research ship by M.I.T. and Maine Maritime Academy students who worked from it this summer off Castine, Maine. They had three missions—to learn the hard facts of oceanographic work, to seek the remains of an American Revolutionary War fleet, and to study coastal currents, aquatic life, and water quality. The scuttled fleet was found quickly enough—an on-deck brickwork oven led to an encrusted cannon which—with per-



mission of the Maine State Museum—was dragged to the surface. "There's an awful lot of mud down there," says Michael B. Kennedy, '75, and "it's sort of unbelievable when it comes up that it was a cannon." Meanwhile, other students spent the four weeks of sun and fresh air using home-made instruments—including the bottom-sampler shown above—to study Holbrook Cove. (Photos: Michael B. Kennedy and Roger Wells)

From 1793 to 1972 in Penobscot Bay; Who Wanted Her Now?

. . . Who, indeed? Every one of the 32 students from M.I.T. and the Maine Maritime Academy who were members of the institution's Sea Grant Summer Laboratory in Castine, Maine, four weeks in July.

"Defense" was one of a fleet of colonial American warships lost when scuttled without even firing at a superior British fleet off what is now Stockton Springs, Maine. Dean Mayhew, Associate Professor of History at Maine Maritime Academy, told the students where he thought she was. Sure enough.

A side-and-bottom-reading sonar designed by M.I.T. ocean engineering students planning for the summer expedition quickly confirmed an anomaly on the bottom exactly where Professor Mayhew said it should be. Richard P. Chertow, '73, and Edward L. Murphy, '73, in wet suits with aqualungs, came back after a preliminary inspection: planks, beams, bricks, and other gear, all considerably deteriorated and covered with layers of plants and mud.

After a week the students and Willard F. Searle, Jr., N.E.'52, Senior Lecturer at M.I.T. who was their "salvage mentor" during the Laboratory, had the state of Maine's permission to bring up a few artifacts—some wood, bricks, and one cannon. The rest remains in Penobscot Bay.

Finding "Defense" was only part of the Summer Laboratory's task. Indeed, more than half the students concentrated their efforts on "finding everything that went on" in Holbrook Cove, a small indentation surrounding an island just east of Castine. Their goal was to learn about tides, currents, pollution, temperature, salinity, and life. They quickly discovered that everything in Holbrook Cove is complicated by the fact that waste water from an open-pit zinc mine just above sea level is discharged into a dammed inlet and thence to the Cove by way of Goose Falls.

The problem was to start from scratch, by building the instruments to make the measurements:

☐ A "flying saucer" (large, lid-shaped dish) poured level full of styrofoam with a wooden cross extending into the water below, for a current meter.

☐ Another current meter: a pressure cooker fitted with clock and tape recorder, sensing the movement of a vane when strung between surface and bottom of the cove.

☐ A turbidity meter, measuring the attenuation of light passing through water between a source and a receiver.

☐ A recording tide gauge, made with a rotating drum to which was fitted a pencil, riding inside a pipe.

☐ Water and mud samplers, to collect samples above and below Goose Falls and from presumably "cleaner" nearby bays.

Immense amounts of data are still to be reduced as this is written, two weeks after the students are back from their quarters aboard the Maritime Academy's training ship "State of Maine." That finished, the agenda will be plans for next summer.

Just as oceanographers win some and lose some when it comes to making instruments work in the hostile marine environment, so this summer's students. The tide gauge had "unbelievably good machine work" but it recorded tidal changes in step-functions because there still was too much friction in the mechanism. A magnetometer which worked in air simply wouldn't work in water; why? A corer made with sharp cutting edges, the better to penetrate hard sediments, was used with a nylon line; but the edges were sharp enough to cut the tow line, too—even before a single sample had come up.

There is, thinks Keating Keays, N.E. '55, Administrative Officer of the Department of Ocean Engineering, no better way to learn how the ocean challenges engineers.

Here Are Some Other Ways To Improve Classless Summer Days

If you're not in ocean engineering (*see above*) and don't want to register for an ordinary Summer Session class, what can you do at M.I.T. for three months between Commencement and Registration Day?

The alternatives divide themselves into "conventional" and "unconventional," and with typical journalistic license this account will dismiss the former with a perfunctory nonstatistical statement: several hundred undergraduates were employed during the 1972 summer in M.I.T. laboratories in on-going research, some on special projects financed by grants from the National Science Foundation and other agencies. No one had an "ordinary" experience, and everyone had the advantage of combining professional with financial advancement.

The "unconventional" things make more interesting reading. And they also tell something about the changing interests of M.I.T. undergraduates in the eighth decade of the 20th century.

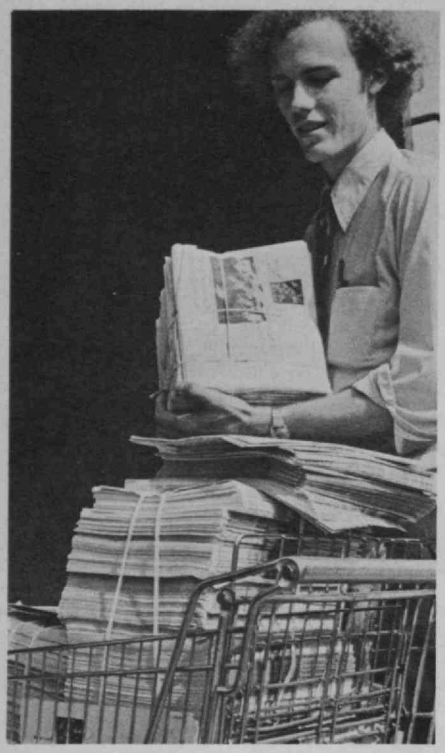
Urban Legal Services Program

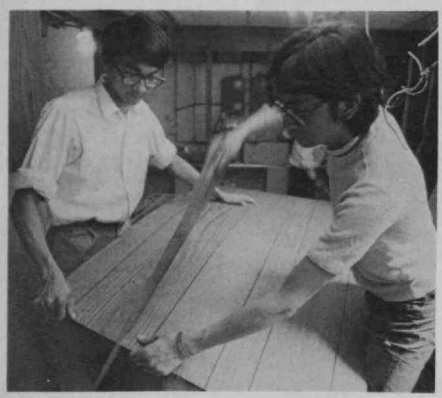
Some 32 M.I.T. and Wellesley students used the format of U.L.S.P. to learn how to tackle social problems in the context of the legal profession. Most took on the work as a stage toward legal careers, but a few came into the program out of what Scott M. Hebert, '72, calls the "Perry Mason syndrome"—simple ignorance of what the law entails.

The result, in either case, was supposed to be better understanding of the potential of law as a vehicle of social change. Some examples of U.L.S.P. activities:

☐ Mark D. Abkowitz, '74, worked with Massachusetts Representative James Smith of Lynn on plans for increasing the efficiency of the Massachusetts Bay Transportation Authority. His conclusions are headed for the desk of Governor Francis W. Sargent, '39.

☐ Marilyn Dorn (Wellesley '74) and Neil B. Cohen, '74, went to work to literally create the Boston Housing Court, authorized by the City Council a year ago but not yet in business when the summer began. They found a courtroom, fought for a budget, and found an advisory group, and by the end of the summer the





Summer at M.I.T.: studying how to recycle the prodigious daily throughput of paper, building a golden-age health center, and testing Roxbury children for lead poisoning. (Photos: Marc J. PoKempner and Margaret Foote)

Court was beginning to work on landlord-tenant disputes.

☐ Believing that the process for handling juvenile offenders in the U.S. is a "failure," Joseph G. Hadzima, Jr., '73, spent the summer with the State Department of Youth Services. He was seeking alternative programs for identifying troubled juveniles and placing them in community-based centers with access to school and job opportunities.

Recycling and Ice Cream

"Right now we're interested in interviewing secretaries," they told *Tech Talk* at mid-summer.

And who isn't? But for Fred P. Gross, '73, and Douglas W. Brogan, '75, it was serious business. They spent the summer wondering how to recycle the paper that passes into M.I.T.'s wastebaskets every day. They found questions but no answers: How much is there? What kind? Where? The idea was to devise, if possible, a practical Institute-wide recycling program.

As a result of the students' work, says Donald Whiston, '32, Deputy Director of M.I.T.'s Physical Plant, "in six months I can see waste paper from 80 per cent of the campus being recycled."

Ice cream, rubber, nylon, and soap were products of a laboratory operated by Kathleen D. Cole, '73, and David E. Cincotta, '73, at the Group School in North Cambridge. With help from Robert S. Langer, a graduate student in chemical engineering, Miss Cole and Mr. Cincotta were devising a new chemistry course to teach Group School students how chemistry affects their day-to-day lives.

Why study chemistry? asked the eight Group School summer session students testing the course on which Mr. Cincotta and Miss Cole were working. To answer the question they all made a batch of ice cream, discovering in the process how salt lowers the freezing point of water—and then of other things.

Community and Urban Services

Can students' summer jobs really help resolve problems of health care and social isolation in big cities?

No certain answer yet, but that was the goal of some 15 summer activities of 54 M.I.T. students under the banner of Student Summer Projects in Community Affairs. The work ranged from landscape planning for public housing projects to fund-raising for black cultural groups. Examples:

☐ In South Cove at the edge of Boston's Chinatown, John Tsang, '73, and Albert K. F. Lau, '72, remodelled the basement of the Golden Age Center into a health center for the elderly—and obtained assurances from four physicians and seven nurses that they will volunteer to man the center for several hours each week this fall. The plan is to provide simple health examinations and tests—and referrals as necessary to more complete services.

☐ Two M.I.T. graduate students, themselves both from Puerto Rico, spent the summer working in the Puerto Rican community of the Dorchester section of Boston. Roberto Marrero Aldea and Edwin Quiles had as their object "to enhance the community's sense of identity" so it could better organize itself to solve its problems.

☐ 1971 voter registration records show that 500 elderly people live within five minutes' walk of St. Clement's Student Parish in the Fenway, Boston. So Ralph M. Rusin, '73, spent the summer organizing and promoting a social club in the Parish headquarters.

☐ In a Somerville housing project, trash is collected in open bins—which were too much of a temptation for the local youngsters, so there were frequent fires and constant troubles. George F. Vitek, '72, found the residents interested in a better plan and asked James F. Hudson, an M.I.T. graduate student specializing in solid waste problems, to describe some alternatives. As a result, the residents are applying for federal funds to upgrade rubbish disposal.

☐ Dean G. Freedlander, '72, Mitch Kaplan, '73, and Mr. Vitek together surveyed one ward in Somerville to determine health service needs. It turned out that—among other deficiencies, there are no preventive health services for the elderly in the area; now there is a basis for answering the question, How can they be provided?

Disciplining the R.O.T.C. Trespassers

Court action continues in the cases of 31 students, former students, and employees charged with trespass by M.I.T. in connection with the occupation of R.O.T.C. offices on May 12 and 13 (*see* Technology Review *for June, pp. 74-76*).

Internal disciplinary action also continues with respect to 21 of those charged who are students at M.I.T.; the cases of three students who were scheduled to graduate in June were reviewed prior to Graduation by the Committee on Discipline, but the Committee's decisions will not be announced until action on all cases is completed.

Records of the Third District Court of Middlesex County show that six of the defendants in M.I.T.'s action have been found not guilty; most of them denied presence in the R.O.T.C. offices at the time M.I.T. officials announced on May 12, "You are trespassing; you will be disciplined." The cases of five defendants were "filed" for periods of three to six months with notations of sufficient evidence to warrant a finding of guilty; the District Attorney urged all defendants to have their cases filed for continuance, but only five agreed to do so. Sixteen defendants were fined $100 each, two were given 30-day sentences in the Middlesex County House of Correction, and one was given both $100 fine and 30-day sentence; all those sentenced have appealed, and their cases will be heard before Superior Court at a date not yet announced.

Daniel Ellsberg's M.I.T. Office . . .

. . . has a new tenant; Dr. Ellsberg's appointment as Senior Research Associate in the M.I.T. Center for International Studies ended routinely, without fanfare

or controversy, in mid-summer.

Dr. Ellsberg, whose trial for espionage, conspiracy, and theft of government property in connection with disclosure of the "Pentagon Papers" stands adjourned in Los Angeles, originally came to the Center in 1970 on a one-year appointment. His assignment was research on American government decision-making in times of crisis; no teaching duties were included.

His research—including essays published as *Papers on the War* (Simon and Schuster, 1972)—completed, Dr. Ellsberg's appointment ended on schedule in July, 1972, according to Eugene B. Skolnikoff, '49, Director of the Center.

Dr. Ellsberg's acknowledgments in *Papers on the War* include Everett E. Hagen, who was Director of the Center when Dr. Ellsberg joined it, and the C.I.S. itself, "which encouraged and supported this work.")

Centrex: How to Dial M.I.T. Direct

Effective August 12, M.I.T. had new telephone numbers and better telephone service—both the result of new Centrex service installed by New England Telephone during the summer.

The Institute's new number is 253-1000 (area code 617). But the Centrex equipment makes it possible for those outside the Institute to dial extension numbers directly if they know them; thus *Technology Review*, which is extension 4871, may be dialed directly as 253-4871. The dormitory telephone system will continue to operate independently, with service from the outside available only through 253-1000. The Draper Laboratory's number is 258-1000, with direct dialing to all extension telephones.

Together, these represent the largest single in-house telephone system in New England, with over 12,600 telephones.

Lead in My Paint?

City dwellers worried about that question can send paint samples to M.I.T. for analysis—no charge.

It's a service of staff and technicians in the Electron Optics Laboratory, working overtime on evening and week-ends, who have now studied more than 100 paint samples. The plan began two years ago, when Robert E. Ogilvie, Sc.D.'54, Professor of Metallurgy who heads the Laboratory, began offering free paint analysis to hospitals in Greater Boston; several responded—notably the Poison Center at the Children's Hospital.

With Professor Ogilvie on leave this year, the work is continued by Jay Herman, technician in the Laboratory. A paint chip about 1 inch square is needed for analysis, and individuals and groups are urged to collect chips from house and household items, package each sample separately in plastic to avoid contamination, and send them—with stamped return envelope—to Mr. Herman. Since most samples show some level of lead from air pollutants, Mr. Herman suggests that he can better interpret his results if he knows the source of each paint sample—exterior or interior, wall or furniture.

Technology in Search of Mission?

The links between Harvard and M.I.T. are now more direct and simultaneous than ever before—the result of successful testing of a direct microwave system between the two institutions this summer by the University Information Technology Corp. (UNITEL), a joint Harvard-M.I.T. nonprofit venture in educational technology development.

The link, which actually ties together the Information Processing Center at M.I.T. and Harvard's counterpart Office of Information Technology, will serve for exchanging computer-formatted data and video signals simultaneously. This summer's test, being the first video conference by telecommunication between the two schools, emphasized the new system's capability for open, interactive exchange.

To improve the system, said James B. Roberts of UNITEL, "we hope to interest someone at M.I.T. or Harvard in using the system in a teaching situation." He thinks it ideally suited for a seminar in which students from the two institutions are cross-registered.

Honor for Food Regulation

Food and drug regulation may be a hard field in which to succeed, but Ross A. Chapman, Assistant Deputy Minister—Food and Drugs in the Canadian Department of National Health and Welfare, will receive M.I.T.'s tenth annual Underwood-Prescott Memorial Award on September 28 for his contributions to it.

Dr. Chapman is prominently identified with the development of international standards for food and food additives, and his honor is for "contributions in laying a sound foundation . . . for regulatory procedures for the food and drug industries," according to the selection committee chaired by Samuel A. Goldblith, '40, Professor of Food Technology.

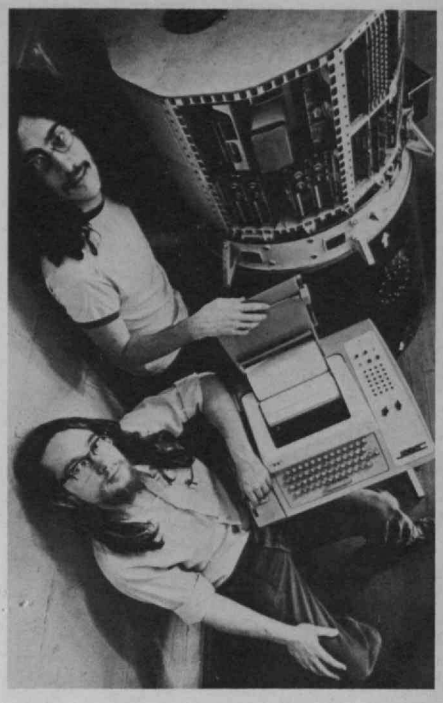
The award will be presented at a special luncheon at M.I.T., to be followed by an afternoon symposium on technical and consumer interests in food. Participants, in addition to Dr. Chapman, are to include Mrs. Esther Peterson, Consumer Adviser to Giant Food, Inc., Washington, D.C., who was formerly President Lyndon B. Johnson's Special Assistant for Consumer Affairs; Sherwin Gardner, Deputy Commissioner of the U.S. Food and Drug Administration; and Richard L. Hall, Vice President for Research and Development of McCormick and Co., Inc.

A $250,000 Computer for $40

Some 1,000 Minuteman I computers, designed to guide intercontinental ballistic missiles to their targets, are now obsolete and surplus, replaced by Minuteman III. Last spring M.I.T.'s Education Research Center acquired such a surplus $250,000 computer—for the $40 shipping charges—from the National Science Foundation, and a group of undergraduates set out to convert it into a general-purpose machine. The result is that a $40 computer will be in use in E.R.C. this fall.

Patrick Peterson, '72, spent the spring developing and building the circuits needed to communicate with the computer through a conventional teletypewriter. That done, Jawaid Ghani, '75, who knew nothing about computers when he came to the Institute from Karachi, Pakistan, in 1971, began writing programs in a basic computer language so that the computer could test its own components. Other programs to help users gain access to the machine and to allow the computer to control other machines were written by George Miller, '73, and Stephen Tepper, '72.

E.R.C.'s private computer turns out to be versatile enough to perform many of the operations to which large computers are usually assigned—but its lower capacity is reflected in lower speed.

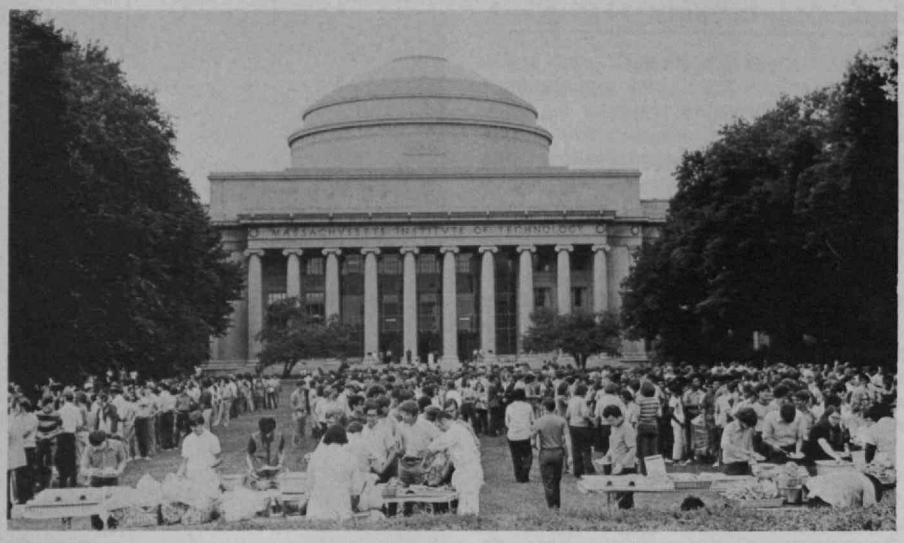


Patrick Peterson, '72, and Stephen Tepper, '72, pose with the surplus Minuteman I computer which they helped turn into a general-purpose machine for M.I.T.'s Education Research Center. To help others make similar conversions, Mr. Peterson has written an instruction book about how to do the job with an investment of some time and a few hundred dollars' worth of additional electronic components. (Photo: Marc PoKempner)

Aharon Katchalsky Memorials

Though his name appeared in no official rosters of M.I.T. faculty or staff, Aharon K. Katchalsky "worked very closely" with the Institute's Neurosciences Research Program; Francis O. Schmitt, the Program's Director, says he was one of its "most creative and best loved associates."

To honor Dr. Katchalsky—he was a victim of the May 30 massacre in Israel's Lod Airport—the Neurosciences Research Program has now established a senior fellowship in biophysical chemistry applied to neuroscience, and it welcomes nominations of suitable fellows. N.R.P. will also honor Dr. Katchalsky by dedi-



"I'm a freshman—you want to rush me?" First their suitcases filled the Student Center, then 1,056 freshmen (and a few friends, including President Jerome B. Wiesner) filled the Great Court for a roast beef picnic and the start of orientation on September 1. It turned out to be the largest freshman class in M.I.T. history. (Photos: Marc J. PoKempner and Margaret Foote)

cating the proceedings from its 1972 summer intensive study program in Boulder, Colo., to him; and the Colorado program itself included a special lecture in Dr. Katchalsky's honor. (The Weizmann Institute of Science, where Dr. Katchalsky headed the Polymer Research Department, also plans a memorial, the nature of which remains to be determined.)

The Class of 1976 Arrives

"We'd like to have everyone come as far forward as possible," said a voice emanating from two bullhorns aimed at M.I.T.'s Great Court, and, in response, several hundred entering freshmen assembled there began to move forward from where they had been eating or talking or throwing frisbees. They gathered at the steps of Building Ten. "What you went through [a freshman picnic] was probably the most organized thing you'll go through this week," the bullhorns said. "Welcome to M.I.T."

The picnic, on Friday, September 1, marked the beginning of Residence/Orientation, or R/O, Week. In three days, the class of 1976 would decide where they wished to live, in six, what courses they wished to register for, and in eleven days, classes would begin. During R/O Week, freshmen would meet their advisors, and have the opportunity at two "midways" to learn of elective courses and extracurricular activities at the Institute. On the final days before registration day and the beginning of classes, they would have time to make themselves at home in their chosen living groups.

Larry Dagate, '74, at a microphone, introduced President Jerome Wiesner: "The president of M.I.T. wants to turn out more than just smart machines."

"Next week, Mrs. Wiesner and I will have a chance to greet all of you personally. In the meantime, make yourselves at home," Dr. Wiesner said, and then moved into the substance of a speech that, in its breadth and carefulness, seemed an echo of his inaugural address of a year ago rather than casual remarks of the sort that Dr. Wiesner himself made fast work of as "diversity of the academic menu, and so on."

"All of us here regard the student body as our most important asset," Dr. Wiesner told the entering class, adding that though the freshmen may have chosen M.I.T. for the excellence of its faculty, faculty members often choose a school for the excellence of its student body.

"You are bucking the contemporary mood," Dr. Wiesner told them, in choosing a scientific or technical education, but "to protect the human spirit, to give it more scope . . . an education is vital to that task."

"M.I.T. is a place for men and women to learn how to learn," Dr. Wiesner concluded, "but life is far from a problem set . . . It is the breadth of knowledge and human qualities that will sustain you."

The picnic's program of speeches continued with a representative from the fraternities, and one from the dormitory system. At one point, a speaker's description of R/O Week as similar to algebra in that "it's associative, commutative, and complex" earned hisses from the freshmen. Hissing by M.I.T. undergraduates is usually in response to a rather special sort of stimulus; that the entering freshmen on the first day of R/O Week could already hiss leads to the conclusion that hissing is an innate behavior pattern here.

While the speeches were ending—"Though I still believe it will be too much to handle, I think this week can be very valuable" . . . "a certain kind of maturity, in which you have to deal with other people" . . . "believe it or not, we're getting that many professors together—to talk with you!" . . . "I don't think anybody should go through this week confused. There's so many people that want to help you. Please have a good time." . . . a line was forming on Memorial Drive, spanning that side of the Great Court. It was composed of hunting parties from the fraternities, looking for pledges. "No further than the sidewalk!" barked an R/O Week coordinator through a bullhorn.

The picnic ended at 7 o'clock, the official beginning time for rushing. The freshmen turned away from Building Ten and moved toward the hungry line of fraternities. They seemed all right after the speeches, in spite of the belief that "the unusual stresses present when moving into a new environment can seem insurmountable at times, especially under the forced atmosphere that often develops during R/O Week," expressed by the R/O Week schedule.

"I'm a freshman!" exclaimed one of the first to reach the fraternity horde. "You want to rush me?"

"We're all freshmen!" exclaimed a chorus of his fellows. "Rush us!"

Two freshman women wandered toward the side of the line. "They don't want

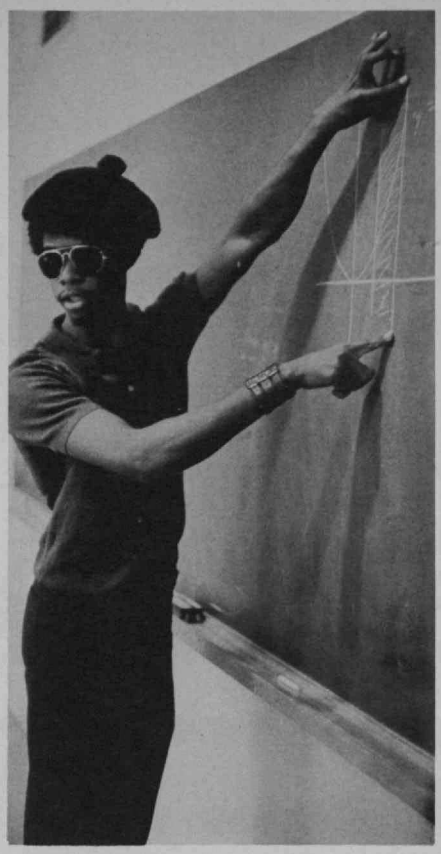
us," said one. "We're the wrong sex." She thought for a fraction of a second, then smiled broadly. "Actually, we're the right sex," she said.

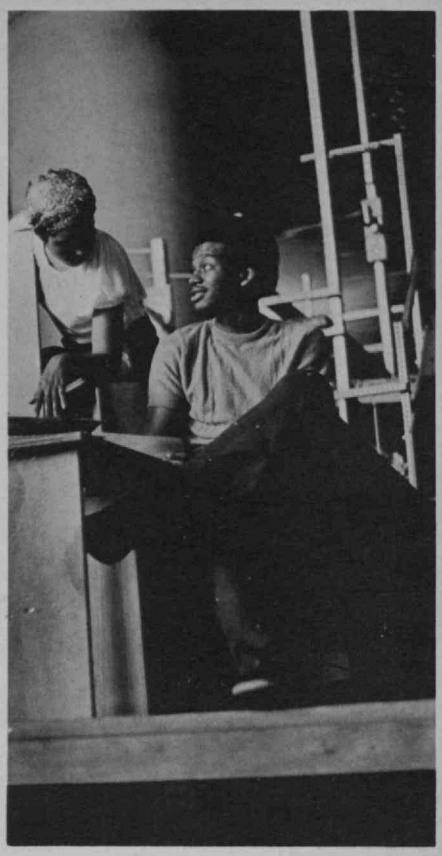
For 23 Freshmen, M.I.T. Was "Old Hat" When Orientation Began

They were members of the Institute's "Project Interphase," a seven-week introduction designed to ease the transition into M.I.T. for students who are qualified to do M.I.T. work but whose educational backgrounds are very different from those of typical freshmen. They came from as far as El Paso and Houston, Texas, and as near as Jamaica Plain; but Lee D. Giguere, '73, interviewing some of the 19 men and four women for *The Tech,* found their reactions "solidly favorable" to a school where the professors "know their stuff."

Interphase studies, from June 25 to August 11, included physics, calculus, and photography or music workshops; chemistry was offered for those planning to concentrate in chemically-related fields. The cost of Interphase participation—tuition, room, board, travel, and a small allowance for personal expenses—was borne by M.I.T., and successful participants received 18 units of elective credit.

Albert Oliver of Philadelphia told Mr. Giguere that he was "crazy about Boston City Hall" and that it was a "great feeling" to be at M.I.T. Peter Garcia of El Paso, who didn't look forward to summer school, said, "I like it fine." And he thought that without Interphase M.I.T. "would have been hard in the fall." Harold Caldwell of Flint, Mich., found it "not easy but interesting," and James Banks of Newport, R. I., said everyone was "up to his neck in work."





The point of M.I.T.'s Project Interphase is to "patch up" deficiencies in the academic backgrounds of students who are qualified for M.I.T. work but whose preparation for M.I.T. classes may not be adequate. This summer's group of 23 studied calculus, using the regular freshman text and quizzes, and physics, as an introduction to the way those are taught at M.I.T.; and they took workshops in photography or music because they "wanted things that involved their talents and their hands," according to James J. Bishop, Assistant Dean for Student Affairs.

The Goal: To "De-mythify Incorrect Assumptions About Women at M.I.T."

J. Daniel Nyhart, then Dean for Student Affairs, could hardly have expected the *ad hoc* committee on women students at M.I.T. which he appointed last year to be satisfied with the *status quo.* The report, which invokes the phrase and remarkable verb of the headline, leaves no doubt.

Its underlying themes are "the need for women at M.I.T. to be supported and encouraged in their pursuit of scientific, technical, or quantitative social science education" and the circumstances from which the committee concludes that M.I.T.'s academic environment "does not always assist a woman in attaining her goals."

Unfortunately, says the Committee, "numerous instances" were brought to its attention "where women had encountered either open hostility, lavish or total lack of attention, demeaning and embarrassing comments, or other subtle forms of sexual discrimination."

Indeed, "there is a feeling among some women students that M.I.T. does not support their being here. . . . If many people at the Institute persist in feeling that women jeopardize the quality of M.I.T.'s education, that women do not belong in traditionally male engineering and management fields, that women cannot be expected to make serious commitments to scientific pursuits, that women lack academic motivation, that women can only serve as distractions in the classroom, then M.I.T. will never, and can never, be a coed institution with equal opportunities for all of its members."

Part of the problem is simply the present minority position of women at M.I.T.; it is "a male-dominated community," and simply by the force of numbers "the woman's influence in the Institute is ineffectively diffuse and/or nonexistent."

And the blame is not wholly M.I.T.'s. Social mores encourage women in certain roles and discourage them in others. "A discriminatory attitude against women is so institutionalized in American universities as to be out of the awareness of many of those contributing to it," says the report. And it admits that, "in the matrix of a society that practices sex role stereotyping, M.I.T. cannot by itself guarantee women their full humanity. "But it can contribute to that goal more fully than it has."

The *ad hoc* committee was chaired by Mildred S. Dresselhaus, Associate Head of the Department of Electrical Engineering, and Paula J. Stone, '72, who graduated last spring in the Department of Civil Engineering. Its members in addition included one man, Jon Hartshorne, Assistant to the Dean for Student Affairs; Dr. Carola B. Eisenberg, who has now succeeded Professor Nyhart as Dean for Student Affairs; three undergraduate and three graduate students; three additional members of the staff and faculty; and one member of the Corporation—Mrs. Christina H. Jansen, '63, of the Polaroid Corporation.

After its general preamble, the committee report proceeds to a series of comments and recommendations on various aspects of Institute life and affairs:

☐ *Admissions:* To increase the number of women students at M.I.T. seems to the committee vital, and it proposes a campaign to spread knowledge of "the presence and success of women" at M.I.T.

The Gallery

Though the pace of life in Cambridge slows during the summer, M.I.T. is seldom as quiet as the main corridor scene above. The other pictures in this month's Gallery show what really happened when just under 2,000 students and perhaps a third of the faculty settled in for the season. Informality rarely gave way to formality; even Michael Egirous closed Charlie-the-Tech-Tailor for a month's triumphant return to Greece. One event (lower right): Howard R. Webber, Director of the M.I.T. Press, feted Paul A. Samuelson, Professor of Economics, by passing the first copy of Volume 3 of his collected writings to President Jerome B. Wiesner (left).
(Photos: Margaret Foote and Marc PoKempner)

This would include visits by women to high schools—and especially to girls' schools; a special effort to overcome "the inordinate lack of knowledge" about women at M.I.T. on the part of members of the Educational Council; and a program to put coeds in touch with women applicants for admission.

☐ *Financial Aid:* There is "no conscious attempt" to maintain different award strategies for men and women and thus "no sexual discrimination" in awarding M.I.T. financial aid. Yet the committee found that more families of women than of men pay their M.I.T. students' bills ("there appears to be less financial need among female students") and that those women students who do receive nonscholarship financial aid tend to take more of it in term-time jobs and less in short-term loans than men. Women who take term-time jobs tend to end up in "menial tasks" in libraries, dining services, and residence halls instead of finding work in laboratories as technicians or programmers. The reasons for these differences are not clear and should be studied, says the committee.

☐ *Academic environment:* The committee reports that "women students do not feel that they are always taken seriously as students," saying the outcome is that "some female students at M.I.T. feel that they are being educationally shortchanged." The committee cites professors who comment on "what nice distractions 'his girls' " are for male students, who single out women for special treatment in classroom or laboratory, who focus attention on men because "few women are successful after they acquire their degrees."

☐ *Faculty:* At present only two per cent of the M.I.T. faculty are women. Needless to say, the committee urges that the proportion be raised. There should also be a woman in the Office of the Dean for Student Affairs "who would have primary (but not exclusive) responsibility for women students" and would serve as "a woman's advocate."

☐ *Extracurricular activities:* Coeds are involved in over 100 student activities, and more in proportion to their number than male students take part. But they nevertheless must sometimes "cope with second-class citizenship, male-oriented leadership, teasing, and other barriers—both formal and informal." Alpha Phi Omega, the service fraternity, is an outstanding exception. Though the national fraternity will not admit women, the M.I.T. chapter has "successfully integrated" coeds into all its activities, and it has struggled at national conventions to change the fraternity's discriminatory policy.

☐ *Athletics:* Lack of facilities has made coed participation in athletics difficult in the past, but this is gradually being rectified. Nevertheless, coed athletes "are often not taken seriously by the Athletic Department," says the committee report; but it admits that this is more a reflection of broad social attitudes than any local discrimination.

☐ *Housing:* Two issues are of concern: an all-female dormitory should continue at M.I.T. for those who want it; and the number of women in existing coed dormitories should be increased from the present small minorities before additional coed living groups are established.

☐ *The Wellesley Exchange:* Many people view the Wellesley-M.I.T. exchange plan more as a social than an intellectual opportunity, and this reflects on the seriousness with which all women at M.I.T. are taken in their academic work. Let M.I.T. coeds participate in planning the Wellesley-M.I.T. exchange program, and let academic rather than social criteria be emphasized for participation.

☐ *Medical Needs:* General health care for women at M.I.T. is "excellent"—including the stand of the Medical Department on birth control. There are instances of "condescending attitudes by physicians" which should be eliminated, and the committee proposes a better gynecology clinic, sex education programs, an obstetric service, and child care programs.

Minority Affairs Appointment

James C. Allison, for four years the Institute's Opportunity Development Officer, has joined the President's and Provost's office as Assistant for Minority Affairs. He will have a leading role in developing and coordinating the Institute's affirmative action programs to expand educational and career opportunities at M.I.T. for minority groups.

Mr. Allison will work directly with Institute departments and offices to prepare and help them implement affirmative action programs—including programs for women, now being developed. He will also maintain contact with community and federal agencies in the field of minority rights.

First employed as a marine designer and later in the professional personnel department at General Dynamics Corp., Quincy, Mr. Allison came to M.I.T. after serving as Director of Operations for the Opportunities Industrialization Center, Boston. He is a native of Pawtucket and studied at Roger Williams Junior College.

Steven W. Maxwell, 1954-1972

Steven W. Maxwell, '75, was fatally injured on July 31 while climbing near Lewis and Clark State Park 20 miles east of Portland, Ore. He had entered the Institute a year ago from David Douglas High School, Portland, and was a member of Sigma Chi fraternity.

Mr. Maxwell was climbing with a companion on Kellogg Butte at the time of the accident; he lost his hold during a rapell down the rocky north face of the Butte and was caught by his safety rope which—in a freak accident—tightened around his neck.

Wyman P. Fiske, 1900-1972

Wyman P. Fiske, who served on the M.I.T. faculty in the Departments of Economics and of Business and Engineering Administration for nearly 20 years beginning in 1929, died at his home in Greenwich, Conn., on July 13. He was 72.

During his service in the Department of Business and Engineering Administration, now the Sloan School of Management, Professor Fiske directed its Sponsored Fellowship Program; he left the Institute in 1948 to pursue a full-time career as management consultant, from which he retired in 1965. Mr. Fiske was a former President and Executive Secretary of the National Association of Accountants.

J. C. Allison

Stephen M. Nagy, 1911-1972

Stephen M. Nagy, '51, a distinguished microanalyst who was a member of the research staff of the Center for Materials Science and Engineering, died at his summer home in Hampstead, N.H., on May 29. He was 61.

Dr. Nagy first joined M.I.T. in 1945, and for most of the period from then until 1968 he was in charge of the microchemical laboratories in the Department of Chemistry. He studied at Franklin and Marshall College, New York University, and Columbia University; and before coming to M.I.T. he had been a cancer research fellow at Lenox Hill Hospital, New York, and an associate of the Rockefeller Institute for Medical Research. For his World War II work at the latter, Dr. Nagy received a Presidential Citation, and he held an honorary Doctor of Science degree from his alma mater in 1951.

Individuals Noteworthy

Awards and Honors: **Stanley Backer,** '41, to Honorary Member, American Society for Testing and Materials . . . to **Pietro Belluschi,** Dean, School of Architecture and Planning, the American Institute of Architects' Gold Medal . . . **Jay W. Forrester,** '45, to Benjamin Franklin Fellow, Royal Society of Arts, London . . . to **Kerson Huang,** '50, a Fulbright-Hays lecture grant, Latin American School of Physics, Caracas, Venezuela . . . to **Amos E. Joel, Jr.,** 40, the 1972 Achievement Award, I.E.E.E. Communications Society . . . to **Irving Kaplan,** Department of Nuclear Engineering, the Arthur H. Compton Award from the American Nuclear Society . . . **Mitchell F. Keamy,** '47, to General Manager of the Year, Cement and Mining Systems Division, Allis-Chalmers Corp. . . . **Peter E. Norris,** '65, to David Sarnoff Fellow from R.C.A. Laboratories, Princeton N.J. . . . to **Robert M. Palter,** '57, the Robert L. Greenberg Leadership Award of the Jewish Federation, Council of Greater Los Angeles . . . to **Wilfred M. Post, Jr.,** '36, the highest award for service, American Association of Airport Executives . . . to **Charles E. Reed,** '34, the Carborundum Company's

1972 Award for Excellence in Chemicals . . . to **John F. Rockart,** Ph.D.'68, M.I.T. Professor of Management, the Western Electric Fund Award for Education Innovation in Higher Education for Business Administration . . . to **Paul A. Samuelson,** M.I.T. Professor of Economics, Harvard's Honorary Doctor of Law Degree and named by President Nixon one of four American Scholars in Lincoln lectureship program by the Board of Foreign Scholarships . . . **Eugene Skolnikoff,** '49, Department of Political Science, one of nine scholars invited by State Department to study its external research program . . . to **Leonard R. Sugerman,** '55, the 1971 Norman P. Hays Award for outstanding achievements in navigation, U.S. Air Force . . . to **Victor F. Weisskopf,** M.I.T. Professor and Head of Department of Physics, the Cino-Del Duca International Award.

Professional and Corporate Changes: **W. Leslie Allison,** '50, to Financial Officer, Chemicals Group, Olin Corp. . . . **Robert C. K. Au,** '55, to partner, Dames & Moore, Consulting Engineers . . . **Richard A. Bator,** '65, to Software Systems Manager, I.M.L.A.C. Corp. . . . **George W. Bartlett,** '43, to President, Neway Division, Lear Siegler, Inc. . . . **Horace S. Beattie,** '33, to Vice President, I.B.M. . . . **Charles A. Berg,** '56, to Deputy Director for Engineering, Institute for Applied Technology, National Bureau of Standards, U.S. Department of Commerce . . . **William F. Blitzer,** '45, to President and Chairman, Executive Committee, Lightolier Inc. . . . **P. L. Thibaut Brian,** Sc.D'56, to Vice President and Senior Engineering Officer, Air Products and Chemicals . . . **Philip A. Campbell,** S.M.'70, to Vice President, Customer Services, New Jersey Bell . . . **Colby H. Chandler,** S. M.'63, to Director of Photographic Program Development, U.S. and Canadian Photographic Division, Eastman Kodak Co. . . . **Peter C. Darin, Jr.,** '51, to Executive Vice President, Darin & Armstrong, Inc. . . . **Robert S. Davis,** Sc.D.'55, to Vice President—Industrial Systems, Systems Division, Computer Sciences Corp. . . . **Jerome Holland,** M.I.T. Corporation, to Director of New York Stock Exchange . . . **David S. Greenlaw,** S.M.'57, to Director of Advanced Planning, Eastman Kodak Co. . . . **John M. Hollywood,** '31, to Senior Electronic Engineer, Goldmark Communications Corp. . . . **Albert J. Kelley,** '48, to Director, L.F.E. Corp. . . . **Amos Levin,** S.M.'66, to Director of Management Information Systems, Eastern Gas and Fuel Associates . . . **Howard O. McMahon,** Ph.D.'41, to Board of Directors, CTi Cryogenic Technology Inc. . . . **Richard A. Mezger,** '61, to Assistant Vice President, Planning and Development, Computer Services Division, State Street Bank and Trust Co. . . . **John D. Northup,** '32, to Vice President—Manufacturing, Owens-Illinois, Inc. . . . **Robert P. Popadic,** '64, to Vice President, Administration and Control Department, Computer Services Division, State Street Bank and Trust Co. . . . **Thomas R. Williams,** S.M.'54, to President, Chief Administrative Officer and Director, First National Holding Corp.

Professional Societies: **Paul H. Attridge,** '55, to President, Highway Safety Associates . . . **Richard A. Carpenter,** '64, to Director, Environmental Studies Board, National Academy of Sciences and National Academy of Engineering; **Alain Enthoven,** Ph.D.'56, to Institute of Medicine, National Academy of Sciences . . . **David K. Hardin,** '49, to President, American Marketing Association . . . **Edward A. Mason,** Sc.D.'48, to Board of Directors, American Nuclear Society . . . **James B. Reswick,** '43, to Member, Institute of Medicine, National Academy of Science . . . **Charles L. Storrs,** '49, to Board of Directors of American Nuclear Society.

Appointments: **John E. Burchard,** '23, Dean Emeritus, M.I.T. School of Humanities, to San Francisco Bay Area Rapid Transit Art Council . . . **James A. Fay,** S.M.'47, M.I.T. Professor of Mechanical Engineering, to Chairman, Massachusetts Port Authority . . . **Frederick W. Gander, Jr.** '65, to Committee on Manpower and Employment, Labor Department . . . **T. Marshall Hahn, Jr.,** Ph.D.'50, to National Science Board, National Science Foundation . . . **Howard O. McMahon,** '41, to President's Committee on National Medal of Science . . . **Howard S. Turner,** Ph.D.'36, to Member of President's Science Advisory Committee . . . **Howard W. Johnson,** Chairman M.I.T. Corporation, to Trustee, Woods Hole Oceanographic Institution . . . **Russell DeYoung,** S.M.'40; **J. K. Jamieson,** '31; **C. B. McCoy,** '32, and **Frank R. Milliken,** '34, to National Industrial Pollution Control Council, U.S. Department of Commerce . . . **Burton B. Crocker,** S.M.'47, to Vice President, **Bernard J. Steigerwald,** S.M.'56, to Director, Air Pollution Control Association.

Deceased

Andrew D. Fuller, '95, July 26, 1972
Frederick A. Hunnewell, '97, July 1, 1972
Julius Alsberg, '02, August 14, 1972
Harlen M. Chapman, '02, May 20, 1972*
Albert E. Lombard, '02, May 17, 1972*
Roger D. Babson, '03, May 1, 1972*
George B. Bradshaw, '03, May 17, 1972*
Edna G. Burdette, '04, June 22, 1972*
H. Kinsley Draper, '04, n.d.*
Malcolm Bruce, '06, November 20, 1971
Walter D. Davol, '06, May 19, 1972*
H. O. C. Ingraham, '06, May 3, 1972*
Anthony P. Mathesius, '06, July 2, 1969
Arthur T. Trowbridge, '06, December 31, 1971*
Robert Amory, '08, July 20, 1972
Eugene L. Brown, Jr., '08, July 9, 1972
Edward P. Chapman, '09, December 19, 1971
Thornwell Fay, Jr., '09, November 14, 1969
Paul H. Mayer, '09, January 14, 1972
Philip A. Devlin, '10, January 9, 1971
Richard C. Jacobs, Jr., '10, December 19, 1971.
Harold C. Manson, '10, June 1, 1972
Philip L. Caldwell, '11, May 13, 1972*
Henry Wood, '11, May 17, 1972
Joseph A. Boyer, '12, May 7, 1972
William F. Herbert, '13, April 22, 1972
Thorn Dickinson, '14, August 14, 1972
Frank E. Dunn, '14, June 12, 1972*
Philip L. Scannell, '14, January 13, 1972
Augustus S. True, '14, October 2, 1964
Edward C. Wente, '14, June 9, 1972
Henry C. Adams, Jr., '15, February 26, 1970
J. Harland Billings, '15, September 29, 1971
Harold C. Fuller, '16, March 31, 1972
Lee H. Jones, '16, August 2, 1972
Marshall S. Wellington, '16, June 26, 1972*
George A. Nelson, '17, May 17, 1970
Joshua C. Whetzel, '17, April 26, 1972
Donald D. Warner, '18, July 18, 1971
Fred P. Baker, '19, May 29, 1972
Paul G. Jenney, '19, January 25, 1972
Walter R. McKenney, '19, May 31, 1972
Ralph H. Pease, '19, August 16, 1971
Arklay S. Richards, '19, June 30, 1972*
Will Hooper, '20, October 1971
Irwin L. Moore, '20, July 21, 1972*
Robert H. Van Volkenburgh, '20, March 6, 1972*
Edward S. Brown, '21, April 18, 1971
Vernon C. Cole, '21, May 30, 1972*
Harold A. Greenwald, '21, June 25, 1972*
Walter A. Jayme, '21, January 1, 1972
Norborne L. Rawlings, '21, May 2, 1972
Saul M. Silverstein, '21, May 15, 1972*
Lyall L. Stuart, '21, May 30, 1972
Irving Ball, '22, March 22, 1971
Charles W. Boughton, '22, December 1970
Charles L. Gilkeson, '22, May 30, 1972
Morris J. Gordon, '22, May 30, 1972
Reider Paulsen, '22, December 26, 1941
Elizabeth G. Pietsch, '22, November 26, 1971
William A. Riley, '22, June 21, 1972
Richard J. Sholtz, '22, July 18, 1968
Karol O. Stensrud, '22, February 5, 1964
Paul A. Bray, '23, May 21, 1971

Van Court M. Hare, '23, 1971
Robert E. Hendrie, '23, January 13, 1972
Eduardo Icaza, '23, May 28, 1972
Richard W. Lambrecht, '23, May 13, 1972
Philip Lemler, '23, August 1971
Walter E. Richards, '23, July 1972*
Maurice A. Spaulding, '23, August 31, 1970
Marion I. Walters, '23, May 6, 1971
William Webster, '23, May 17, 1972*
Gerald L. White, '23, January 20, 1972
Alfred L. Bailey, '24, February 15, 1972
Sidney M. Doyle, '24, June 27, 1972*
Oscar A. Keefe, '24, June 18, 1972
John R. Tench, '24, July 11, 1972*
Martin L. Tressel, '24, June 14, 1972*
John W. DeKay, '25, January 17, 1972
George W. MacDuff, '25, April 3, 1972*
Daniel D. F. Yellott, '25, April 28, 1971
Duncan A. Crawford, '26, May 9, 1972
Harold Fox, '26, November 29, 1971
Allan W. Lundstrum, '26, May 21, 1972
Philip M. Richardson, '26, August 13, 1972.
Donald G. Welch, '26, December 8, 1971
John S. Buhler, '27, May 2, 1972*
Laurence Burns, '27, June 4, 1972*
Marcel DuBois, '27, August 10, 1970*
Ernest H. Dodge, '27, April 16, 1972*
E. James Sax, '27, December 8, 1971*
Carl R. Sydenstricker, '27, February 4, 1972
Leland D. Webb, '27, September 12, 1971
John Stack, '28, June 18, 1972*
William W. Olmstead, Jr., '29, May 22, 1972
William R. Tarbox, '29, June 13, 1972*
Hubert V. Hopkins, '30, July 12, 1972
Tufic Antonio Chemor, '31, January 15, 1972
Nathaniel Coburn, '31, June 22, 1971
John Fairfield, '31, November 13, 1971
Irving W. Finberg, '31, October 30, 1971
Harland Glidden, '31, October '71
Jacob Gordon, '31, July 26, 1972
William H. Jacobs, '31, June 19, 1972
Irwin M. Lord, '31, March 1, 1972
William C. Mentzer, '31, December 23, 1971
Scott B. Ritchie, '31, April 28, 1972
Carl O. Svensson, '31, January 9, 1972
George H. Carter, '32, June 12, 1972
Julio J. Gallese C., '32, August 31, 1971
William M. Hayes, '32, July 3, 1972
Samuel Cauman, '33, March 6, 1971
Antonio De Lorenzo, '33, June 20, 1972
William E. Howard, '33, June 14, 1972*
Anthony N. Mooradian, '34, June 10, 1971*
William L. Reed, '34, May 1, 1970
William Sample, Jr., '34, May 8, 1972*
William L. Abramowitz, '35, July 23, 1972*
Carlos F. Lavenas, '35, July 25, 1972*
John B. Meakin, '35, February 1972
William B. Allen, '36, January 12, 1972
Daniel Rhee, '36, June 27, 1971
Carl H. Muehlemeyer, '37, July 20, 1972
David S. Geer, '38, April 30, 1972
Robert W. Ferguson, '41, January 13, 1972
William G. Duvall, '42, May 12, 1972
Henry H. Hoadley, '43, February 6, 1970
Ian B. H. Bennett, '44, May 4, 1972
Theodore N. Hellmuth, '44, July 2, 1963
Charles H. Gray, '46, September 4, 1971
Lawrence J. Poudrier, '50, August 12, 1971
Stephen M. Nagy, '51, May 29, 1972
Lewis W. Crump, '52, October 14, 1970*
James O. Putnam, '54, June 17, 1972
John A. Gower, '55, February 22, 1972
John M. Davies, '56, May 9, 1971
Peter A. Franken, '56, June 20, 1972
Joseph Seserman, '56, March 20, 1968
Edward C. Stivers, '57, June 18, 1972
Conrad Johannes, '60, April 5, 1971
Richard C. Hull, '63, May 14, 1972
Ben M. Soievetz, '63, December 4, 1968
William L. Hendry, '66, June 22, 1972
*Further information in *Class Review*

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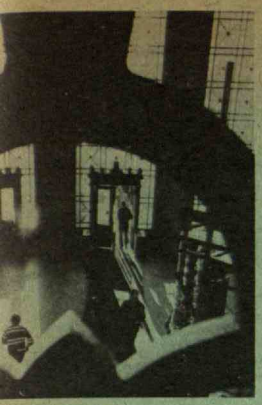


A BANNER YEAR...$2,793,743...HIGHEST EVER...UP $229,348 FROM '71...22,067 DONORS...SEVENTH CONSECUTIVE RECORD...GRADUATE PARTICIPATION UP 2 POINTS TO 36%...38 CLASSES/COURSES BEAT 50%...OVERALL PARTICIPATION 44%... $5,000,000 TOTAL ALUMNI GIVING

The 1972 Alumni Fund

of the Massachusetts Institute of Technology

The 1972 M.I.T. Alumni Fund

OFFICE OF THE PRESIDENT

CAMBRIDGE, MASSACHUSETTS 02139

August 2, 1972

Dr. Howard O. McMahon
Arthur D. Little, Inc.
25 Acorn Park
Cambridge, MA 02140

Dear Howard:

In 1969, when the Alumni Fund reached a then-record, we were very grateful. The two succeeding years also led to respectable totals, considering the times, but, admittedly, 1972 had to be viewed with unease considering the economic situation, the general unrest in the country, etc.

It is against this background that we particularly appreciate the Fund's 1971-72 performance. These are new records in which every alumnus can take particular pride, and give us here a greater spur in dealing with the unique technological, academic, and financial complexities of our time.

During the year, Chancellor Paul Gray and I met with thousands of alumni. We shared our concerns, and we heard theirs, and we are trying to be responsive to them. We clearly sensed the commitment to the continued greatness of the Institute throughout the world-wide M. I. T. community. Your report eloquently affirms these impressions.

Thank you and all who have made this great year possible.

Sincerely yours,

Jerome B. Wiesner
President

JBW/jh

M.I.T. Alumni have done it again!

Although the 1971-1972 year was marked by a persistent "softness" in technical employment and general economic uncertainty, the Alumni Fund set new records to continue its past impressive history.

Fund Year	Donors	Amount
1964	14,971	$1,080,594
1965	15,225	1,206,763
1966	16,272	1,777,443
1967	17,545	2,023,562
1968	18,771	2,425,000
1969	19,829	2,680,077
1970	20,461	2,301,176
1971	21,344	2,564,395
1972	22,067	2,793,743

In every one of these years, the number of donors has surpassed the previous year's total; in seven of the nine years, total gifts have done the same. This achievement is matched by few, if any, major university funds. It is a striking witness to the deep convictions of M.I.T. alumni. It is, above all, a "vote" which inspires the confidence of those who lead the Institute in complicated times.

As the Fund has reached these pinnacles, there has also been an intensive effort to control Institute expenditures and eliminate deficits. It has been an impressive and effective performance, and an assurance that alumni generosity and prudent administration will undergird the momentum that M.I.T. must have.

Dr. Wiesner has expressed the Institute's appreciation. I can only add, on behalf of the Alumni Fund Board, thank you very much.

Howard O McMahon

Howard O. McMahon, CM '41
Chairman, Alumni Fund Board

Alumni gifts reached $5,000,000
Outstanding gifts from 25-, 40- and 50-year reunion classes

Highlights of 1972

Total alumni giving

Alumni gifts to M.I.T. through all channels, including the Fund, reached $5,000,000.

Reunions

For the five years ending with their reunions, the 25, 40, and 50-year classes work to make outstanding gifts. Their announcements of the total gifts of their classmates over the five years are highlights of each Alumni Day.

'47—$728,388!

Richard S. Mooney, Reunion Gift Chairman for the Class of 1947, reported a record 25 year gift from 439 members of the class. The class of '35 previously held the record. Under an achievement program for high levels of giving in the Class of '47, special awards were given to 6 Leader Beavers, 5 Eager Beavers, and 62 Beavers.

MOONEY

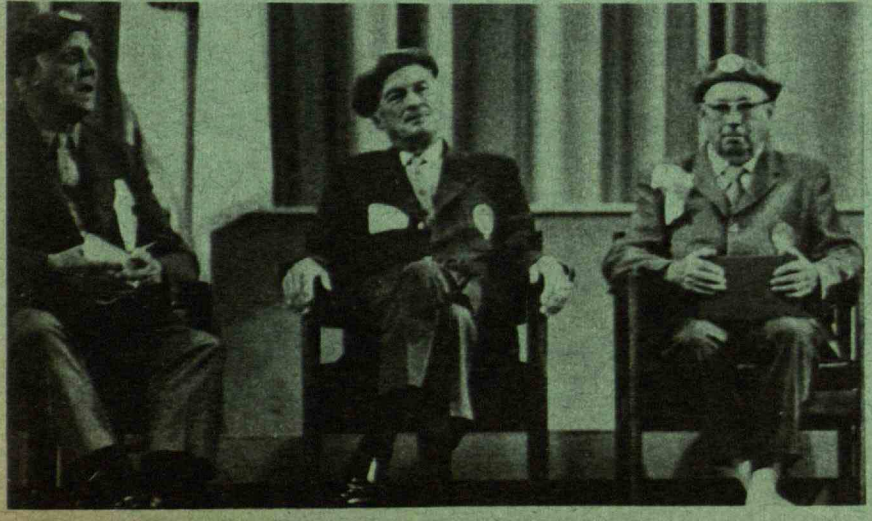
'32—$369,123!

Thomas E. Sears, Jr., Class Agent, speaking for Robert B. Semple, Reunion Gift Chairman, announced the 40th Reunion Gift contributed by 319 members of the Class of 1932 who graduated in the year of "insurmountable opportunity."

SEARS

'22—$910,939!

Parke D. Appel, President of the Class of 1922, Dale D. Spoor, Class Agent, and Donald F. Carpenter, Reunion Gift Chairman, jointly announced a record 50th Reunion Gift from 337 members of the class, breaking the previous record set by '17. In addition, 28 classmates had notified the Institute that it will be a beneficiary of their estates, with total proceeds conservatively estimated to be in excess of $685,000.



L. TO R.: SPOOR, CARPENTER, AND APPEL

New records set for reunion classes, matching gifts, estate plans

Reunion	Class	Contributors, per cent	Amount
65th	'07	60	$51,710*
60	'12	61	4,570
45	'27	54	57,023
35	'37	53*	24,225
30	'42	52*	19,846
20	'52	44	24,238
15	'57	46	12,969
10	'62	46*	42,564*
5	'67	51	7,404

* New record

Many other classes were also celebrating reunions, making these occasions to increase their giving. Their gifts to the Alumni Fund set 5 new records for their respective reunion years.

A precedent-setting 55 year gift consisting of two parts was announced by John Lunn, President of the Class of 1917. The first part is a $100,000 M.I.T. 1917 Memorial Endowment Fund, and the second is a M.I.T. 1917 Buzz Aldrin Scholarship Fund for Aeronautics and Astronautics which amounts to $80,768. Edwin E. Aldrin, Sr., father of the astronaut, is a member of the Class of 1917. "Buzz" Aldrin received his Doctorate in Aeronautical Engineering at the Institute in 1963 and is an honorary member of '17.

Geographic Programs

In scope, these programs involve more volunteers than any other alumni program. Area Councils establish local policy (there are 11 Councils); Area Leadership groups solicit those who can make larger gifts (42 areas were organized this year, up from 32 in 1971); Regional Solicitors reach the non-donors on a community-neighborhood basis (164 regions were in operation this year vs. 269 last); and telethons round out the coverage. The decrease in number of Regions reflects conversion of a substantial portion of the Regional program to telethons. Complete details are on the following pages.

Matching Gifts

This year 1,728 alumni had their gifts matched by their employers. Under this program, 203 companies contributed $128,012. In 1971, 213 companies gave the Fund $117,273 in matching the gifts of 1,619 alumni.

Parents Fund

The fourth year of the Parents Fund provided gifts of $6,690 from 201 donors. Abraham L. Gray (son: Mark L. '73) was chairman.

'72

The Senior Class Gift totaled $4,041 in three-year pledges made by 58 classmates.

Uses and Designations

The Alumni Fund encourages all gifts to M.I.T. Some classes have their own objectives, such as professorships; some individuals support a specific activity, such as a scholarship or endowment fund; others designate their gifts for a variety of purposes; all contribute to the betterment of M.I.T. It is the policy to allocate undesignated Alumni Fund receipts, insofar as possible, to the improvement of student environment—housing, financial aid, and extra-curricular activities. During 1972, Fund receipts were donor-designated as shown in table at left.

One particular designation is the Independent Residence Development Fund for financing low-cost loans to houses such as fraternities. This year 1,162 alumni designated $118,521 to the I.R.D.F.

Uses and Designations	Per cent
General purpose or otherwise undesignated	39
Financial aid	8
Housing, including I.R.D.F.	5
Extra-curricular	4
Academic departments, including professorships	20
Other designated purposes	24

Estate Secretaries

Each Class after its Twenty-fifth Reunion appoints an Estate Secretary to inform classmates of opportunities and to suggest that they include M.I.T. in their estate plans. Over the years, their efforts have encouraged many alumni to make these important arrangements. Currently, more than 700 alumni and over 100 other friends have notified the Institute of plans for future gifts.

Memorial Gifts

Many alumni and friends were memorialized by their relatives or friends through gifts to M.I.T.

Courtlandt W. Babcock '05
Earl W. Pilling '10
Henry C. Harrison '13
Edgar H. Weil '13
Steven R. Berke '16
Charles D. Proctor '17
Arthur Smith '18
Daniel C. Hall '19
Homer V. Howes '20
Ernest Henderson '21
Raymond A. St. Laurent '21
Frederick S. Blackall, Jr. '22
Duncan R. Linsley '22
Avery A. Ashdown CM '24
Theron P. Bailey '24
Earle S. Bates '24
Henry B. Kane '24
Robert P. Siskind '24
Edward Wininger '24
Sarkis M. Zartarian '24
David Goldman '25
Mac Levine '25
Ralph T. Jope '28
Elmer A. Skonberg '29
John W. Campbell, Jr. '33
Bradley L. Newcomb '40
Philip I. Perry '54
Robert W. Hawkes EC '57
Otis C. Myers, Jr. EE '58
Christopher G. Scott '67
John B. Rugo

Classes and Courses

There were over 2,800 alumni gifts of $100 or more.

Note especially the classes under 20 years graduated; four of these classes have percentage participations of 50% or higher. Yet it was only three years ago that the first under-20-years-graduated class achieved the distinction of reaching the 50% level.

Also note the Graduate School. There were 395 more donors than a year ago, representing 55% of the total donor increase for the entire Fund.

Classes and Courses
The Leaders*

Largest Amounts

Of all classes	1923	$189,341
Of classes 24 years or less graduated	1951	154,143
Of classes 26 to 49 years graduated	1923	189,341
Of classes 51 years or more graduated	1916	103,121
Graduate course	Chem. Eng.	130,596

Highest per cent participation

Of all classes	1913	71%
Of classes 24 years or less graduated	1959	53%
Of classes 26 to 49 years graduated	1924	57%
	1928	57%
Of classes 51 years or more graduated	1913	71%
Graduate course	Sloan Fellows	54%

* Excluding major reunion classes 1922, 1932, 1947.

The 1972 Alumni Fund

July 1, 1971 to June 30, 1972

Class	Active Members	Donors to '72 Fund	Per Cent Participation	Fund Gifts	Other Gifts	Total Gifts
Thru 1900	23	10	43	$ 42,009	$ 550,522	$ 592,531
1901						
●Edward H. Davis[1]	4	2	50*	951*	5,066	$ 6,017
1902	12	5	42	145		145
1903						
Robert J. King[1]	20	10	50	965		965
1904	25	17	68*	1,060	25,555	26,615
1905	32	19	59	7,345*		7,345
1906	43	17	40	640		640
1907	40	25	60	51,710*	514,361	566,071
1908						
Wilfred E. Booth[1]						
Howard B. Luther[2]	59	33	56	3,881	94,415	98,296
1909						
Henry K. Spencer[1,2]	64	32	50	34,959*	3,026	37,985
1910						
John B. Babcock, III[1]						
Walter T. Spalding[2]	61	31	51	3,223*	1,158	4,381
1911						
Oswald W. Stewart[1]						
James F. Duffy[2] ‡	88	58	66	5,352	1,000	6,352
1912						
Albion R. Davis[1]						
Jonathan A. Noyes[2]	90	55	61	4,570		4,570
1913						
●Ellis W. Brewster[1]	103	73	71*	4,630		4,630
1914						
C. H. Chatfield[1]	94	59	63	14,346		14,346
1915						
●James B. Neal[1,2]	135	92	68*	8,331	10,500	18,831
1916						
●Joseph W. Barker[1,2]	168	100	60*	103,121*	60,938	164,059
1917						
●A. Raymond Brooks[1]						
●Stanley C. Dunning[1]						
Raymond Stevens[2]	209	126	60*	25,555*	3,000	28,555
1918						
Julian C. Howe[1]						
Saxton W. Fletcher[2]	191	107	56	8,508	102,500	111,008
1919						
●Dean K. Webster, Jr.[1]						
Paul D. Sheeline[2]	192	94	49*	21,507*		21,507
1920						
Percy Bugbee[1]						
Alan W. Burke[1]						
Pierre F. Lavedan[2] ‡	248	142	57	22,828*		22,828
1921						
Edouard N. Dubé[1]						
Edmund G. Farrand[1,2]	397	215	54	19,962	47,060	67,022
1922						
●Dale D. Spoor[1]						
Donald F. Carpenter[2,3]						
Parke D. Appel[3]	534	307	57*	71,731*	1	71,732
1923						
Herbert L. Hayden[1]						
Philip L. Coleman[2]						
David W. Skinner[3]	467	236	50	189,341*	484,438	673,779
1924						
Frank R. Shaw[1]						
Hood Worthington[2]						
John F. Hennessy[3]	425	241	57	65,522*	106,551	172,073
1925						
Samuel R. Spiker[1]						
Harrison Browning[2]						
Garvin A. Drew[3]	421	214	51*	67,187*	5,000	72,187
1926						
Chenery Salmon[1]						
Thornton W. Owen[2]						
I. Austin Kelly[3]	494	246	50	90,954*	3,185	94,139
1927						
Richard P. Hawkins[1]						
William L. Taggart[2]	463	252	54*	57,023*		57,023
1928						
●Charles E. Worthen[1]	484	275	57*	19,897		19,897
1929						
●W. Gordon Bowie[1]	480	214	45*	73,764*	33,838	107,602
1930						
●Joseph Harrington, Jr.[2]	499					
M. Otto Zigler[1]		228	46*	80,564*	10,000	90,564
1931						
John R. Swanton, Jr.[1]						
Ralph H. Davis[2]						
Edward B. Hubbard[3]	535	230	43	44,529		44,529
1932						
●Thomas E. Sears, Jr.[1]						
Gaynor H. Langsdorf[2]						
Robert B. Semple[3]	483	253	52*	131,714*	57,156	188,870

Class	Active Members	Donors to '72 Fund	Per Cent Participation
1933			
●Robert H. White[1]			
Ellis C. Littmann[2,3]	499	274	55*
1934			
E. Philip Kron[1]			
William H. Mills[2]			
Frank R. Milliken[3]	518	278	54*
1935			
Leo M. Beckwith[1]			
William L. Abramowitz[2,3] ‡	460	232	50*
1936			
Henry F. Lippitt, II[1]			
G. Elliott Robinson[1]			
Vincent T. Estabrook[2]			
Edward L. Dashefsky[3]	419	201	48
1937			
●H. Arthur Zimmerman[1]			
George S. DeArment[2]	367	193	53*
1938			
●Frank B. Kemp[1]			
David A. Wright[2]	408	190	47*
1939			
Seymour J. Sheinkopf[1]			
Manning C. Morrill[2]	463	229	49
1940			
N. Bruce Duffett[1]			
Thomas F. Creamer[2]	533	267	50
1941			
●Carl M. Mueller[1]			
Howard J. Samuels[2]	480	243	51*
1942			
●Paul L. Hotte[1]			
Floyd A. Lyon[2]	523	272	52*
1943			
●James O. McDonough[1]			
Stanley M. Proctor[2]	500	243	49*
1944			
Norman I. Sebell[1]			
E. Alfred Picardi[2]	726	303	42
1945			
●Robert N. Maglathlin[1]			
Max E. Ruehrmund, Jr.[2]	334	146	44*
1946			
Theodore P. Heuchling[1]	503	213	42
1947			
Jack W. Rizika[1]			
Richard S. Mooney[2]	647	320	49*
1948			
●D. Dennis Allegretti[1]			
Jack C. Page[2]	1,063	505	48*
1949			
E. Milton Bevington[1]			
Leonard F. Newton[2]	781	366	47
1950			
●Robert A. Cesari[1]			
●Donald R. Miller[1]			
Norman B. Champ, Jr.[2]	1,031	503	49*
1951			
William L. Maini[1]			
Richard C. Reedy[1]			
Breene M. Kerr[2]	925	456	49
1952			
●Stanley H. Sydney[1]	809	360	44*
1953			
Maurice P. Gionfriddo[1]	658	314	48*
1954			
●Charles J. Masison, Jr.[1]	643	309	48*
1955			
●F. Eugene Davis, IV[1]			
●R. Peter Toohy[1]	631	300	48*
1956			
Roy F. Mennell[1]	744	382	51*
1957			
Edward B. Roberts[1]	732	340	46
1958			
●Robert E. Jordan, III[1]	746	371	50*
1959			
Richard L. Sampson[1]	745	392	53
1960			
●Burgess H. Rhodes[1]			
●Noel S. Bartlett[1]	746	330	44*
1961			
Grady W. Harris[1]	713	311	44
1962			
Steven J. Smith[1]	717	334	46
1963			
Peter T. Van Aken[1]	760	336	44*
1964			
James W. Giffin[1]	748	340	45*

Fund Gifts	Other Gifts	Total Gifts
51,392	1,719	53,111
55,762	1,000	56,762
47,295		47,295
14,368		14,368
24,225		24,225
53,839		53,839
14,159		14,159
68,144	52,768	120,912
40,897		40,897
19,846		19,846
18,749		18,749
19,584		19,584
12,729		12,729
12,739		12,739
87,721*	58,450	146,171
45,513	26	45,539
29,371	1,681	31,052
70,954*	14,008	84,962
154,143*	58	154,201
24,238*	253	24,491
11,280*		11,280
9,812*	237	10,049
8,637*	154	8,791
11,356*	147	11,503
12,969*		12,969
10,314*		10,314
29,062*		29,062
52,388*		52,388
10,101*		10,101
42,564*		42,564
7,307		7,307
7,803*		7,803

Class	Active Members	Donors to '72 Fund	Per Cent Participation	Fund Gifts	Other Gifts	Total Gifts
1965						
•James A. Wolf[1]	735	359	49*	$ 11,118*	$	$ 11,118
1966						
Kenneth C. Browning[1]	749	361	48	7,488*		7,488
1967						
Charles E. Kolb, Jr.[1]	833	422	51	7,404*		7,404
1968						
•Richard I. Karash[1]	871	416	48*	6,489*		6,489
1969						
James P. Truitt, Jr.[1]	864	357	41*	4,885*		4,885
1970						
Harold L. Federow[1]	745	276	37	4,059*		4,059
1971						
Howard Jay Siegel[1]	688	224	33	3,818		3,818
Classes	**33,640**	**16,286**	**48**	**$2,402,346***	**$2,249,771**	**$4,652,117**

Alumni Who Attended Graduate School Only

	Active Members	Donors to '72 Fund	Per Cent Participation	Fund Gifts	Other Gifts	Total Gifts
Aeronautics						
George C. Grogan, Jr.[1]	1,146	331	29*	$ 8,411*	$	$ 8,411
Architecture						
•Bill C. Boozlotis[1]	508	154	30*	2,962		2,962
Chemical Engineering	1,456	585	40*	130,596*	6,050	136,646
Chemistry						
Charles M. Apt[1]	1,148	400	35*	11,964		11,964
City Planning	343	116	34	6,353*		6,353
Civil Engineering						
•Kenneth G. Fettig[1]	1,322	459	35*	12,033*		12,033
Economics						
Harold E. Dreyer[1]	363	126	35*	4,296*		4,296
Electrical Engineering	2,007	696	35*	36,368	13	36,381
Geology						
Robert R. Shrock[1]	255	87	34	2,372*		2,372
Graduate Management						
•John T. Selldorff[1]	1,048	437	42*	11,289*		11,289
Life Sciences						
•Robert A. Zimmermann[1]	294	85	29*	1,681*		1,681
Mathematics						
•Donald L. Thomsen, Jr.[1]	385	127	33*	52,683*		52,683
Mechanical Engineering						
•Erwin G. Loewen[1]	1,325	420	32*	11,271		11,271
Metallurgy						
Donald J. Blickwede[1]	677	242	36*	7,572		7,572
Meteorology						
•Kenneth A. Campana[1]	377	148	39*	2,516*		2,516
Naval Architecture and Marine Engineering[4]						
Donald P. Courtsal[1]	218	69	32*	1,018		1,018
Naval Construction[4]						
•L. V. Honsinger[1]	748	255	34*	4,291*		4,291
Nuclear Engineering	384	131	34	3,466		3,466
Nutrition						
Alan Cornell[1]	226	58	26	966		966
Physics						
•Colgate W. Darden, III[1]	842	302	36*	12,841*	14	12,855
Senior Executives	131	60	46	3,380		3,380
Sloan Fellows						
Herman R. Staudt[1]	787	422	54	29,820		29,820
Miscellaneous Courses	289	71	25*	1,250*		1,250
Graduate School	**16,279**	**5,781**	**36***	**$ 359,399***	**$ 6,077**	**$ 365,476**
All Alumni	**49,919**	**22,067***	**44**	**$2,761,745***	**$2,255,848**	**$5,017,593**
Friends and Non-Alumni				**31,998***		**31,998**
Alumni Fund		**22,067****		**$2,793,743***		
Alumni Giving						**$5,049,591**

[1] Agent
[2] Class Estate Secretary
[3] Reunion Gift Chairman
[4] This course is now part of the department of Ocean Engineering.
•Agent whose Class/Course participation has increased two or more percentage points over last year.
* Exceeds 1971 results
** In addition, there were 84 other donors representing undergraduates, memorialized alumni, estates and M.I.T. Clubs. The amounts of these gifts are included in the totals.
‡ Deceased

Telethon Programs

By Classes

	Telethon Chairman	Callers	Alumni Spoken To	Pledges	Pledge Rate, Per Cent
1924(c)	Frank R. Shaw	8	69	42	61
27(h)	Richard P. Hawkins	2	16	5	31
28(c)	James Donovan	8	79	45	57
30(h)		1	7	5	71
31(g)		1	8	7	88
32(c)	Thomas E. Sears, Jr.	4	43	28	65
33(c)	Ellis C. Littmann	8	57	30	53
34(g)		2	36	33	92
35(g)	William L. Abramowitz‡	7	36	25	69
37(g)	Josiah S. Heal	5	76	46	61
38(g)	Donald P. Severance	7	76	48	63
39(c)	Seymour J. Sheinkopf	3	45	36	75
40(c)	N. Bruce Duffett	5	54	25	46
41(g)		1	17	6	35
42(c)	Paul L. Hotte	12	125	68	54
43(c)	James O. McDonough	7	103	60	58
44(h)		2	24	5	21
45(g)	Robert N. Maglathlin	4	48	40	83
46(g)	Theodore P. Heuchling	4	25	23	92
47(g)	Albert S. Richardson, Jr.	6	63	56	89
48(c)	Herbert D. Marcus	10	174	128	74
49(c)	Paul E. Weamer	6	80	40	50
50(c)	Robert A. Cesari	7	74	49	66
51(c)	William L. Maini Richard C. Reedy	10	134	90	68
53(c)	Maurice P. Gionfriddo	6	101	69	69
54(c)		5	70	35	50
55(h)		3	40	22	55
56(c)	Roy F. Mennell	9	118	80	68
57(c)	James E. Cunningham	4	53	34	64
58(c)	Glenn P. Strehle	17	235	153	65
59(c)	Charles O. Staples	9	163	126	77
60(c)		5	70	36	52
61(c)	Grady W. Harris	6	70	45	64
62(c)	George M. Wyman	7	60	44	73
63(c)	Herbert C. Doepken	5	55	43	78
64(h)		1	13	6	46
65(h)		5	65	17	26
66(c)	Kenneth C. Browning	4	45	22	49
67(c)	Charles E. Kolb, Jr.	15	132	78	59
68(c)	Richard I. Karash	6	117	59	50

By Courses

AA(g)	Hubert I. Flomenhoft	3	42	33	79
AR(g)	Bill C. Booziotis	4	67	52	78
CE(h)	Peter S. Eagleson	6	54	31	57
CH(c)		3	53	28	53
CP(h)		1	17	6	35
EC(c)		4	45	31	69
EE(c)		3	45	27	60
GM(c)	J. Thomas Selldorff	4	61	43	71
MA(c)		4	65	37	57
ME(c)		2	51	18	35
MT(c)		3	47	18	38
NA(h)		1	11	3	27
NC(c)	Keatinge Keays	3	40	24	60
PH(h)		1	10	3	30
		279	**3484**	**2164**	**62**

* h = telethon reaching long-time non-givers
g = telethon asking good givers to increase their gifts
c = both h and g telethons
‡ Deceased

By Geographic Areas

City	Telethon Chairman	Callers	Alumni Spoken To	Pledges	Pledge Rate, Per Cent
Baltimore	Lawrence Kuszmaul, Jr. '51	7	164	72	44
Boston	George W. Busby, III '68 John L. Danforth '40 John P. Rudy '67	94	1605	796	50

Chicago	Edward J. Amrein, Jr. '59	20		204		100	49
Dallas	James L. Fischer CH '55	10		141		70	50
Hartford	David S. Shefrin '56	8		114		46	40
Houston	Jack L. Larks '52	6		105		66	63
Kansas City	Robert D. Hutton '50	3		30		13	43
Los Angeles—North	Clinton D. Burdick '50	15		219		128	58
Los Angeles—South	Warren H. Martell '30	17		233		131	56
Los Angeles—Total	William B. Bergen '37		32		452		259 57
Miami	Russell L. Law, Jr. '48	10		175		98	56
New Orleans	George J. Foundas '49	6		89		41	46
New York		77		984		587	60
Philadelphia	Clifton W. Corbett '47	18		218		84	39
Pittsburgh	Lawrence W. Mayer '52	11		185		99	54
San Diego	Robert M. Williams '50	10		110		57	52
San Francisco—Peninsula	Richard F. Otte '61	22		341		160	47
San Francisco—Downtown	Barrett B. Roach '62	18		203		93	46
San Francisco—Total	Paul M. Cook '47		40		544		253 47
Washington, D. C.	C. Haskell Small '30	35		307		147	48
Wilmington	Dennis A. Tarczy CH '66	7		132		71	54
Worcester	Richard H. Harris '48	8		90		50	56
		402		**5649**		**2909**	**52**
Grand Totals		**681**		**9133**		**5073**	**56**

Leadership Gifts

Several areas with large concentrations of alumni are organized for solicitation of substantial gifts. Listed below are the results of the campaign initiated in the fall of 1971.

Area	Chairman	Amount
Alabama	John E. Wood, III CM '39	$ 2,315
Baltimore	Robert E. Meyerhoff '44	11,978
Binghamton	Donald E. McGuire '50	2,565
Boston	John L. Danforth '40	79,564
Carolinas	Manning C. Morrill '39	60,924
Chicago	John T. Shutack '43	38,118
Cincinnati	Joseph L. H. Kemper '35	7,217
Cleveland	H. Bruce Fabens '44	17,796
Colorado	Terence L. Gildea '59	11,420
Dallas-Fort Worth	George A. Filak '54	156,672
Detroit	Charles M. Jordan '49	16,370
Eastern PA	Larry D. Schmer '66	55,533
Erie	George S. DeArment '37	2,745
Georgia	Phelps A. Walker '50	1,708
Hartford	William A. Bayer '58	20,962
Houston-Beaumont	Edward R. Allen, Jr. '48	18,552
Indiana	Eugene J. Popma SL '58	6,335
Kansas City	Robert D. Hutton '50	2,210
Los Angeles	Bryant Essick '22	75,739
Maine	Irving Kagan '48	3,208
New Hampshire	William C. Tallman '42	37,884
New Haven	Philip H. Dreissigacker, Jr. '37	23,076
New Orleans	Stuart W. Thayer '48	5,493
*New York	Paul V. Keyser, Jr. '29	494,073
Oklahoma	Alanson W. Chandler '37	136,277
Philadelphia	Hal L. Bemis '35	48,506
Pittsburgh	Edwin H. Seim '40	16,580
Providence	Norman L. Greenman '44	18,188
Rochester	Andrew C. Price, III '50	10,269
St. Louis	DeVere W. Ryckman CE '56	24,045
St. Petersburg	H. Paul Julien CM '55	6,184
San Antonio-Austin	Gifford E. White EE '41	1,645
San Diego	Bernard Edelman '53	3,267
San Francisco	Alfred E. Perlman '23	122,746
Schenectady	J. Spencer Standish '45	39,286
Springfield	Daniel J. O'Connell '29	2,153
Syracuse	William O. Lynch CE '47	3,617
Vermont	C. Douglas Cairns '36	2,340
Virginia	Robert P. Frenzel '48	5,299
Washington, D.C.	Arch C. Scurlock CH '43	30,973
Wisconsin	George Y. Anderson, Jr. '24	4,163
Worcester	Howard S. Lockwood '44	12,046
		$1,640,041

* Includes New York City, Long Island, Westchester-Fairfield, Northern New Jersey, and Poughkeepsie.

Alumni Fund Area Councils

In the following areas of large alumni concentration, Councils have been formed to coordinate Fund programs and adapt them to local conditions:

Area	Chairman
Boston	John L. Danforth '40
Chicago	F. Richard Meyer, III '42
Cleveland	William C. Sessions '26
Dallas-Fort Worth	Edward O. Vetter '42
Los Angeles	William B. Bergen '37
New York	Paul V. Keyser, Jr. '29
Philadelphia	Hal L. Bemis '35
Pittsburgh	W. H. Krome George '40
St. Louis	Ellis C. Littmann '33
San Francisco	Paul M. Cook '47
Washington, D.C.	Thornton W. Owen '26

Regional Solicitation

Since 1957 alumni committees have been formed in many communities to solicit active alumni. The primary objective of these groups is participation. This year 164 communities organized, encompassing 15,361 active alumni. The average percent participation for organized regions was 53.

Region	Chairman	Active Alumni	Donors to '72 Fund	Per Cent
Alabama				
Huntsville	Robert T. Howard, Jr. '42	73	34	47
Alaska	Richard A. Nelson '66	24	10	42
Arizona				
Phoenix	Charles E. Maki '51	111	49	44
*Tucson	Frederick Rubel, Jr. '54	79	63	80
California				
*Contra Costa	Joseph P. McBrien '31	179	106	59
Santa Barbara	John R. Brennand, Jr. EE '59	85	39	46
Colorado				
Colorado Springs	Robert E. De Michaels '60	56	29	52
*Fort Collins	Terry J. Vander Werff '66	23	18	78
Connecticut				
Fairfield	George Jordan '52	68	36	53
Middletown	Richard E. Boraks NU '59	42	19	45
New Haven	Hillel J. Auerbach '58	238	125	53
Norwalk	David F. McGrath '26	32	16	50
Old Greenwich	J. Edward Lynn '37	62	34	55
Stamford	Robert S. Hess '40	128	75	59
Stratford	Thomas M. Murphy '68	33	16	48
*Waterbury	William J. McCurdy '47	92	63	68
Westport	Richard A. Rubino '52	150	83	55
Florida				
Jacksonville	Bruce R. Duggar CH '62	37	22	59
Orlando	Peter C. Hand '48	96	43	45
Georgia				
Atlanta	Thomas E. Ambler, II '62	170	73	43
Augusta	George L. Tuer, Jr. ML '55	20	10	50
Hawaii	Richard R. Lowe CP '61	121	62	51
Idaho				
Idaho Falls	Robert A. Cushman '51	10	5	50
Illinois				
Champaign	G. Howard Martin '53	66	41	62
Peoria	B. Jan Huffman '66	21	9	43
Rockford	Richard H. Baker, III '52	23	13	57
Indiana				
Evansville	Richard L. Murdock '58	10	6	60
Indianapolis	Wendell J. Bridges AA '65	79	40	51
Lafayette	Edward A. Patrick MT '63	66	30	45
Iowa				
Des Moines	Gregor J. Gentleman, Jr. '51	40	26	65
Kentucky				
Louisville	Edward J. Schickli, Jr. '50	64	26	41
Louisiana				
Baton Rouge	David L. Ritter '63	61	35	57
Maine				
*Bangor	Richard C. Gibson '42	21	15	71
Portland	Charles H. Horstmann CE '66	99	51	52
Maryland				
Annapolis	William T. Donahue, Jr. '68	75	32	43
*Bethesda	Thomas P. Meloy '51	193	119	62
*Chevy Chase	Adolph C. Hendrickson '51	151	100	66
No. Prince Georges Cnty.	Dan W. Hoffman '47	175	102	58
*Rockville	William L. Glodt NC '49	236	140	59
*Silver Spring	Philip J. Bonomo AA '54	200	137	69
Massachusetts				
*Acton	Cornelius Peterson '58	176	129	73
Attleboro	Daniel J. Hamilton '54	52	28	54
Bedford	Jerry W. Johnson EE '70	167	72	43
Belmont	George E. Wetmore '50	280	125	45
Brookline	Ronald A. Shulman CH '57	326	189	58
Carlisle-Groton	William H. Dyer, III GM '67	175	88	50
*Chestnut Hill	Eugene R. Eisenberg '43	96	58	60
Fall River	Lester Glickman '32	98	46	47
Gloucester	Kenneth M. Bracy '70	53	24	45
Holliston	John R. Greenwood, III '60	60	38	63

Region
Holyoke
Hudson
Lynnfield
Medford
*Natick
Needham
Newburyport
Newton Highlands
North Adams
Pittsfield
*Reading
Rockland-Hanover
Shrewsbury
Swampscott
Waban
Waltham
Wayland
*Wellesley
*Weston
Weymouth
*Worcester
Michigan
Ann Arbor
Birmingham
Dearborn
Detroit
Grand Rapids
Lansing
Minnesota
Minneapolis
St. Paul
Missouri
Kansas City
Nebraska
Omaha
New Hampshire
Concord
New Jersey
Basking Ridge
*Chatham
*Cranford
Fair Lawn
Morristown
Murray Hill
Newark
Orange
Princeton
*Ridgewood
Trenton
New Mexico
Alamogordo
New York
Albany-Troy
Binghamton
Bronxville
Buffalo
Corning
Ithaca
Kingston
Newburgh
Poughkeepsie
*Rochester
Schenectady
Syracuse
Yonkers
North Carolina
Charlotte
Greensboro-Winston-Salem
Raleigh-Durham
Ohio
*Akron

Chairman	Active Alumni	Donors to '72 Fund	Per Cent
Martin C. Graham '65	50	23	46
Robert Veo '53	66	31	47
Stuart E. Madnick '66	126	58	46
Joseph P. Blake, Jr. '54	57	24	42
Philip A. Untersee '55	81	51	63
David C. Crocker '52	161	89	55
John W. Kilduff '18	68	30	44
Richard A. Mezger '61	67	36	54
Francis G. Jenkins '34	28	16	57
Donald P. Strang '45	37	24	65
Klaus Kubierschky '64	120	74	62
David R. Ludwig '59	38	15	39
Richard H. Harris '48	72	40	56
H. Rowe Austin, Jr. '55	77	32	42
Theodore H. Korelitz '56	88	48	55
Lionel C. Kimerling '65	126	53	42
Goddard C. Parsons '48	169	89	53
Charles L. Gagnebin, III EE '66	259	171	66
Harold Granek '68	176	108	61
Alfred Young, Jr. '50	49	20	41
Arnold A. Kramer '52	78	47	60
Donald T. Axon '44	174	77	44
Guilford W. Forbes '49	221	124	56
Edwin E. Hebb, Jr. '48	41	26	63
Robert A. Lytle, Jr. '62	74	42	57
Lyle F. Warnock, Jr. '55	29	18	62
Herbert S. Amster '56	51	19	37
David F. Juncker '63	172	73	42
Mrs. Frank A. Ubel '54	80	41	51
Robert D. Hutton '50	74	39	53
Gerald J. Fleischli '62	40	23	58
Norman D. Davis '64	32	13	41
L. Alan Jarnagin '58	58	25	43
G. Edwin Hadley '38	91	57	63
Robert N. Summerville '52	32	22	69
Robert W. Shoemaker GM '64	60	34	57
Mason L. Downing '41	110	54	49
Randall H. Kunz '62	89	44	49
David L. Wiesen '54	25	13	52
Richard A. Rabinow GM '68	78	45	58
Kerns H. Powers EE '56	173	91	53
Edward G. Remmers '52	123	75	61
Saul L. Neidleman '51	125	64	51
Leonard R. Sugerman '55	4	2	50
David W. Morrison '64	112	47	42
Jacques E. Linder '55	48	28	58
William P. Van Nostrand '42	47	25	53
Mario S. Di Quilio '48	216	107	50
William T. Brydges '62	67	41	61
Joseph S. Bravman '66	88	32	36
Thomas Cerwonka '50	25	7	28
Thomas Cerwonka '50	42	18	43
Thomas Cerwonka '50	140	68	49
Donald W. Ramsey '50	360	223	62
Martin Hudis NU '70	181	83	46
Joseph J. Bongiovanni '48	132	72	55
Karl A. Miller GM '63	25	10	40
William C. Menzies, Jr. ME '55	42	21	50
Richard L. Carson '57	55	31	56
Jack B. Chaddock ME '49	142	69	49
Vito A. Caravito '62	127	88	69

Region	Chairman	Active Alumni	Donors to '72 Fund	Per Cent
Canton	Robert M. Anderson '47	17	11	65
Cincinnati	Eddy R. Hair '54	250	118	47
*Cleveland	Noel S. Bartlett '60	31	23	74
Cleveland Heights	J. Robert Mansperger '56	161	82	51
*Columbus	G. Woodford Thomas '39	164	110	67
Dayton	Cyril M. Pierce '60	156	90	58
Lakewood	Robert J. Fay '42	81	35	43
*Mansfield	R. Gordon Black '56	10	7	70
*Shaker Heights	Alexander B. Ward '47	96	59	61
Toledo	Paul H. Rothschild '58	51	26	51
Youngstown	Francis J. Bittel '40	38	15	39
Oklahoma				
Oklahoma City	Jack R. Kalman '31	43	26	60
Tulsa	Jack L. Shelton '58	57	38	67
Oregon				
Corvallis	Marvin J. Byer '49	26	14	54
Portland	William L. Carey '50	104	44	42
Pennsylvania				
*Allentown	Robert F. Weimer '61	59	43	73
*Erie	Richard Lamborn '24	59	41	69
*Harrisburg	Jack Kinstlinger CE '54	36	27	75
Lancaster	William T. Dyall PH '48	40	23	58
Reading	George T. DeMoss '52	43	22	51
*Scranton-Wilkes Barre	Howard A. Jacobson '48	20	14	70
York	Neil E. Hopkins '33	24	15	63
Puerto Rico	Javier Mulero CE '69	105	48	46
Rhode Island				
*Barrington	Harold Payson, Jr. GY '63	79	56	71
South Carolina	Robert W. Stewart, Jr. '54	149	68	46
Tennessee				
Knoxville	George R. Jasny CH '52	79	40	51
Memphis	Timothy J. Coleman CH '34	33	15	45
*Nashville	William R. Wilcox '42	50	34	68
Texas				
Amarillo	John B. McCrery '38	6	4	67
Austin	John R. Cogdell EE '63	80	33	41
Beaumont	Robert P. Madrulli '51	27	16	59
Corpus Christi	Donald B. Wood '35	12	7	58
El Paso	Oleg V. Fedoroff EE '63	33	17	52
Utah				
Salt Lake City	Charles M. Swift, Jr. GY '67	86	43	50
Virginia				
Alexandria	Paul M. Robinson, Jr. '44	254	128	50
*Arlington	Milon E. Essoglou '55	184	120	65
Falls Church	David E. Gushee '50	347	194	56
Norfolk	Arthur W. Davenport '23	80	38	48
Richmond	W. Malcolm Watson '34	71	39	55
Washington				
Seattle	Kenneth A. Peterson '58	404	172	43
Tacoma	Irvin J. Frankel NC '43	30	20	67
Wisconsin				
Madison	Richard R. Hughes '42	79	39	49
Milwaukee	Warren A. Lederman '61	106	62	58
Neenah	Daniel J. Hanlon, Jr. '37	37	23	62
Bermuda	Stanley C. Brown CE '65	4	1	25
Canada				
Alberta	A. Hoadley Mitchell '41	36	13	36
Mexico				
Mexico City	Ian M. Clark '61	84	28	33
Monterrey	F. Del Valle Canseco '54	30	14	47
Europe				
Germany	Joseph G. McCoy, Jr. WC '70	82	21	26
Switzerland	Eugene L. Amazon '56	109	40	37
Asia				
Israel	William L. Abramowitz '35‡	107	9	8
Japan	Michael L. Jablow '62	155	20	13
Oceania				
Australia	Jerome A. Winston '62	67	14	21

* Top ten Regions in each size group (1-75, 76-149, and 150-plus active alumni).
‡ Deceased

If you would like to participate in this vital effort, please write: M.I.T. Alumni Fund, M.I.T., Room E19-439, Cambridge, MA. 02139

The unique strength of M.I.T. is its extraordinary capacity to lead . . . to identify new problems and embryonic technologies when these are scarcely perceived . . . to adapt educational programs to new societal needs while reflecting the improved qualifications and high aspirations of its students . . . to attract scholar-teachers who will inspire . . . to impart a true sense of the first-rate. And, above all, to assume leadership by drawing on a notable history. Change is the very essence of M.I.T., as it is of all technology, and it is solidly based on continuity of the rigor, discipline and high expectations that have always been here.

Inspired leadership, superb students, renowned faculty, first-rate facilities: these are components of M.I.T.'s unique strength. Each must be nurtured, given the opportunity to experiment, to afford failures en route to new insights. In fact, the more rapid the change, the more vexing the questions, the more complicated the world, the greater the pressures on M.I.T. It can neither fall backward nor stand still without betraying its trust to students and society. It must be able to take the risks inherent in charting new routes.

Thus the need for resources:

. . . to enable the best students to study here, and to have sufficient scholarship and loan funds to make that possible.

. . . to afford a faculty of first-rank, having that uniquely inspiring capacity to wed effective teaching with advanced research.

. . . to have facilities—buildings, laboratories, housing, athletic plant—that are responsive to the whole needs of the student: educational, physical, and social.

. . . to embark into new fields, tomorrow's technologies, and be there at the beginning to help shape them . . . to prepare students for roles now but dimly perceived.

To these ends *every* gift is important. Surely it is possible for most alumni to give something. In a large number of modest gifts there is a substantial cumulative total.

Many, too, can give more. Could you raise your previous $10 to $25, $25 to $50, $50 to $100—or more?

If all donors of less than $5,000 had increased their gifts to the next higher category, M.I.T. would have received $1,600,000 more! Please think about it.

. . . and act soon!

Alumni gifts received in 1972

$ Range of Gift	Number	Amount
$1 - $4	328	$ 718
5 - 9	2,231	11,689
10 - 24	9,431	123,837
25 - 49	5,333	144,259
50 - 99	2,226	119,058
100 - 499	2,116	299,272
500 - 999	169	96,133
1000 - 4999	172	285,372
5000 & Over	61	1,510,352

1972 Alumni Fund Board Members

Printed in U.S.A.

Class Review

95

Many readers who turn first to this spot in the class notes will be saddened to learn that **Andrew Fuller,** Class Secretary and only surviving member of the Class of 1895, died on July 26, 1972. He was 98 years old.

Mr. Fuller retired from his civil engineering profession in 1967 after many years as a consulting construction engineer in the Wakefield, Mass., and surrounding Boston areas. He was a member of the Boston Society of Civil Engineers.

A charter member of the M.I.T. Alumni Council and Alumni Advisory Council, Mr. Fuller's service to his fellow classmates and to the Institute is well known. In 1969 he received the Alumni Association's Bronze Beaver Award, which citation reads: "As a student, alumnus, and alumni officer for over 75 years, and especially as Class Secretary, as a charter member of the Alumni Council 60 years ago, and now as a member of the Alumni Advisory Council, he is an inspiration for devoted and effective service to his fellow alumni. It is a privilege for the Alumni Association to pay special tribute and extend sincere thanks from all his fellow alumni officers."

At a memorial service in the M.I.T. Chapel on August 3, John Nolan, Secretary of the Class of 1903, spoke of his friendship with Andrew Fuller and of the inspiration it gave to this younger Class Secretary to see Andrew's great loyalty to his class and classmates. "Andrew took care of his flock as I try to take care of mine," Mr. Nolan added.

This first page of class notes will be a bit different and a little sadder without that ever-cheerful word from the Class of '95 and from our oldest Class Secretary and friend, Andrew Fuller.—K.S.

96

During the summer I was near Schenectady and was fortunate to find Dr. **William D. Coolidge** at home. We had a good visit and he was in good health and excellent spirits. He was anticipating a few days at his camp in the Adirondacks as his son, Larry, was already en route from Colorado. Birthday congratulations are due on October 23 when Dr. Will reaches his 99th milestone.—**Clare Driscoll,** Acting Secretary, 2032 Belmont Rd. N.W., Washington, D.C. 20009

98

During late spring I saw **Joe Riley** in his home in Needham, Mass. He was as peppy as ever. Nieces in Needham and in the south are part of his family, and while there I met a nephew from New Hampshire. Four of his great-nephews are in the army. He said that the last time he was in Cambridge, Howard Johnson (not the restaurant man) was president of M.I.T. and that they had a good chat about the early days. To quote Joe Riley, "No one is left there who remembers the Rogers Building. William Barton Rogers founded the Institute in this building before the Civil War and when there was a scarcity of students he closed it temporarily. I had an excellent picture of it which I gave to Mr. Johnson who appreciated it very much. I got it after graduation when I worked in the Naval Architectural Department. A photographer was sent there to take pictures and I was assigned to help him. His unusual picture of the Rogers Building was taken from the top of the Y.M.C.A. which was then across the street." May Mr. Riley have a happy 96th birthday on November 21. Also **Bob Lacy** who was born eight days earlier on November 13. Best wishes to these classmates whose lives are still filled with service.

Your Secretary is trailering again. This winter Harold and I will reverse the travel by staying in Florida and then going west to see the desert in bloom. Our address through Christmas is c/o Leisure Mobile Park, 28501 SW 152nd Ave., Homestead, Fla. 33030. Mail which is sent to home address is forwarded.—**Mrs. Audrey Jones Jones,** Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

99

Your acting secretary made his annual call on **Carroll Brown** at Rye Beach, N.H. Carroll was very well and in spite of his loss of vision he, with assistance, maintains his vegetable garden, a hobby which he has carried on for many years. —**Norman Seavey,** Acting Secretary, Apt. 514, Lucerne Towers, Orlando, Fla. 32801

02

Two of our classmates have passed on: **Albert E. Lombard** on May 17 and **Harlen M. Chapman** on May 20. Lombard was a native of Kansas City, Mo., and shortly after graduation returned there to engage in the mortgage loan business. He was also the cashier of a small bank but gave it up to pay more attention to the loan business. About 1919 or earlier he moved to Pasadena and engaged in real estate, building houses which he termed "Houses that are Homes." Later he became interested in the Christian Science Church and lists himself as a Christian Science Practitioner and Teacher and it became his principal activity and interest. He leaves a son, Albert E. Lombard, Jr., Vice President of the McDonnell Aircraft Corporation, in St. Louis, and a daughter, Margaret Lombard Heimer, wife of Harry J. Heimer, Newport Beach, California.

Chapman died in Winter Park, Fla. We quote from a local paper: "Harlen Monroe Chapman, 92, 1111 S. Lakemont Ave. Winter Park, died Saturday. A native of Gill, Mass. he was a solid fuel consultant for the U.S. Department of the Interior before retirement. He was a 1902 graduate of M.I.T., a former treasurer and trustee of Russell Sage College, Troy, N.Y. and a member of Winter Park Presbyterian Church, Winter Park University Club and Winter Park Golf Club. Survivors: son, Harlen, Jr., New York City; daughter, Mrs. A. F. Foster Wood, Rock Hill, S.C.; five grandchildren and five great-grandchildren."

Our class was represented at the Alumni Day festivities by Dorothy and **Arthur Collier.** Arthur is still enjoying good health and he and Mrs. Collier

made their annual visit and outing at Deer Isle, Maine. . . . Our oldest member, **Ambrose Bourneuf** still lives alone and attends to all domestic duties himself. Ambrose is one of the fifty oldest alumni as reported by the Alumni Association.—**Burton G. Philbrick,** Secretary, Greycroft Inn, 68 Dane St., Beverly, Mass. 01915

03

The familiar '95 class notes will no longer lead our alumni list in the *Review,* as its loyal Secretary and its last member, Andrew D. Fuller has also joined his departed classmates.

Andrew and your Secretary had developed a long close friendship by our respective duties and vividly lived our daily lives as students amidst the venerable walls of the Richards and Walker buildings in Boston around the turn of the century. Andrew had long been retired from his prominent engineering profession and this afforded him time to devote his remaining days as Secretary to his loving classmates. His keen interest in M.I.T.'s progress for over 75 years granted him the treasured Bronze Beaver award of the Alumni Association. A fitting and touching memorial eulogy was held for him on August 3 in the M.I.T. Chapel, which was attended by his family, his devoted nurse, Ruth Burns, your Secretary and many alumni and friends.

In a recent letter, Isabel Bradshaw writes, "My dear brother, **George Burt Bradshaw** passed away on May 17 at La Porte, Texas, where he lived with his son, George, Jr., M.I.T.'40. On a recent visit to my alma mater, Wellesley, '60, I was unable to locate his later dear M.I.T. friend, Sam Prescott, '33, whose home we often visited and who wrote an historic book, *When M.I.T. Was Boston Tech.*

"My brother George had an interesting busy life, filled with excitement and devotion to his college, his many Tech friends and loyalty to his many employers."

Roger D. Babson, of Longmeadow, Mass., passed away on May 2. He was born in Gloucester, Mass., October 7, 1880 and lived for the past 53 years in East Longmeadow. He was an engineer with Pratt and Whitney until his retirement. He leaves his wife Mary Garvey Babson.

A delayed report from the Alumni office announces the death of **Herbert M. Morley** of Hollywood, Calif., on November 25, 1971. We have no further details.

A more cheerful note was received from our devoted classmate, **Clarence M. Joyce** of Idyllwild, Calif. He misses his world traveling, as his former agility is now much hampered by rheumatism.—**John J. A. Nolan,** Secretary-Treasurer, 13 Linden Ave., Somerville, Mass. 02143

04

We have two deaths to report this month: **H. Kinsley Draper** of Canton, retired general manager of a fruit company in Puerto Rico; and Mrs. **Edna G. Burdette** of San Diego, Calif., of whom her daughter writes "she was always very proud of her affiliation with M.I.T. and spent some of her happiest years there."

A change of address for **Robert Phinney** to 96D Clintwood Court, Rochester, N.Y. —**Eugene H. Russell,** Secretary, 8 Stevens Road, Needham, Mass.

05

Well, we have ascended to the No. 1 table at the Alumni Day Luncheon. Present were Leonard and Bernice Cronkhite, Mr. and Mrs. Henry Buff, Elizabeth Babcock, Art Balkam, Gilbert Tower, Ruth and your Secretary. Don't jump at conclusions, as I did. The Registration Board listed "Mr. and Mrs. Henry Buff," but Mrs. Buff was a very nice young lady, Mrs. McDonald, who said, "My children call Henry 'Grandpa'." So Henry proudly stands as one of our two class bachelors, the other being Gilman Joslin, who now lives permanently in Florida. Seated also at the No. 1 table were Stanley G. H. Fitch, '00, and Mr. and Mrs. Arthur L. Collier, '02, who joined in the hilarity at the "oldest grad" table.

Not much news emanated. We were glad to hear **Len Cronkhite** tell that a threatening medical problem had worked out entirely negative. He looked as fit as a fiddle, as did Bernice. They still spend several months during the wintry season in Arizona writing. Len regularly contributes to the Oxonian (Lardon). **Gib Tower** reported that Elizabeth is well—considering—ambulatory and mentally in good shape. Incidentally and sadly I have to report that Elizabeth Babcock died quite suddenly on July 22. She was in good spirit and apparently good health on Alumni Day. I have no further detail because we know of no kin.

I must apologize for a serious error in my notes in the July-August issue. In referring to our recent trip to Bermuda I wrote "Izzy Nye and Charlie Smart, etc." How the name Nye got into my thinking at the time I'll never know. In the future I should refer to Isabel instead of Izzy.

I am in receipt of a beautiful and touching memorial card from the **Prince Crowell** family in memory of their father, Prince, and their mother, Ethel. It carries a splendid etching of the Crowell home, "To Leeward," with the harbor and racing yachts in the background and enclosing a poem by Ethel, "Thoughts of a Bird Bander," which I wish I could reproduce.

For lack of further material, I must turn personal again. This has been a great year for the Goldthwaits. First, our 50th wedding anniversary in March, then my 90th birthday on July 8. On each occasion our daughters (5) and families collaborated to make the occasion very special. Each time the entire family, sons-in-law and grandchildren gathered from all along the Eastern Coast, as far south as North Carolina—22 in all making both occasions very happy ones.

Since my classmates have not commented on my notes in the July-August *Review,* I must thank Otto Wolff, '29, for calling it to the attention of Mr. George L. Van Bergen, Chief Dam Beaver of

Friends and members of the First Unitarian Church in Center Sandwich, N.H., prepared this party in July to celebrate the 90th birthdays of Mrs. Grace Woodbury of Laconia, N.H., and Fred Goldthwait, '05, of Center Sandwich. As he blows out the candles, we are making a wish for his continued health and happiness.—Eds. (Photo by Paul Bunning, courtesy of the Union-Leader, *Manchester, N.H.)*

"Beavers of America," an association founded in Montreal in 1785. I was awarded a Life Membership. I appreciate the honor as it gives me rights to all "Beaver Dams and Bars" in the United States and Canada.

The next issue, I hope, will not contain any personal news or reminiscences, which means that my classmates must become correspondents and prevent a gap.—**Fred Goldthwait,** Secretary, Box 231, Center Sandwich, N.H. 03227; **William S. Ball,** Assistant Secretary, 6311 Fordham Place, Bayshore Gardens, Bradenton, Fla. 33505

06

Although some of our longtime donors to the Alumni Fund are obliged to drop out, and the amounts have to drop too, there are still a goodly number of donors from '06—about 40 per cent of the 69 living members. One of the consistent givers is **Edwin B. Bartlett,** a longtime resident of Milwaukee. He not only contributes but he uses the envelope to send a note to the class secretary, and the Fund office sends that message to me. Ed says, "I have prospered. I sold out in 1945 and live pleasantly. Am 90 years old. Too bad, but in good health. Wish I was not so far away. I enjoyed Boston very much. I lived a year in Salt Lake City. Took on five wives." Maybe those wives helped Ed to be in good health and live to be 90! Why don't more of you Fund donors send me a message like Ed—or use a postcard to tell me how you are, and what you do and what are your hobbies and interests and who are the classmates with whom you correspond. I am trying to write to Fund givers, but if you don't hear from me—many thanks.

There are three deaths to report: **Walter Davol** died on May 19 in a Manchester, N.H. nursing home. Walter was born Sept. 24, 1883, in Charlestown, Mass., and prepared at Mechanics High in Boston. He was a member of our EE Society and was in the ballet of *The Scientific King*—remember? Walter was in the insurance business, first with Continental and then with Hartford, and had been retired for some years. He was a loyal M.I.T. man and classmate, wrote to the secretary, attended reunions, had paid class dues frequently through the years, and contributed to the Alumni Fund. Walter had a son and a daughter and grandchildren but I have no addresses for condolences.

Harold Otto Carl Ingraham had changed his name, having been Hans O. C. Isenberg. He was born November 15, 1879, in the Hawaiian Islands and died May 3 in Sharon, Conn. He prepared at the Kgl. Technische Hochschule in Munich, Germany, got his degree with our class, his thesis being "Tests on 590 KW Westinghouse-Parsons Turbine", at the Savannah, Georgia Electric Co. He did post-graduate work in Munich and Berlin and then made automobiles for a while. In 1911 he was back in the U.S.A. with Goethals Engineering Co. and was also associated with Scripps-Booth Auto Co. and the Wright-Martin Aircraft Co. before he joined Allied Chemical and Dye Co., becoming president of its general chemical division in 1951. He was cited by the War Department for his leadership in explosives production during WWII. A belated note of sympathy is being sent to the widow.

Arthur Townsend Trowbridge was born August 28, 1883, in Arlington, Mass., always lived there, and died December 31, 1971. He was with Am. Ag. Chem. Co. in Boston for some years and by 1920 was a mechanical engineer with Elevating and Conveying Machinery Co. in Arlington, then was a partner with a Mr. Schellens in Boston. Arthur had been a regular contributor to the Alumni Fund through the years.

If you have a 1907 *Technique* turn to page 58 and enjoy the two-page poem, author unknown, entitled "The Origin and Rise of 1906." It's good.—**Edward B. Rowe,** Secretary-Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

07

An expert on the subject of decorative tiles and ceramics, **E. Stanley Wires** is still quite active in this field, having just co-authored a book on the subject. The publication, *Zanesville Decorative Tiles,* treats the history of the production of decorative tile and the background of the famous ceramic center in Zanesville, Ohio, which produced well-known artistic tiles and ceramics. Mr. Wires kindly sent along a copy of the beautifully illustrated booklet, noting that it is the first article written on the start of the industrial tile business in the United States. After graduation, Mr. Wires became a tile contractor in Boston under the firm name of The Tile Shop and continued in that business until his retirement in 1965. He served as director and vice president for the Tile and Mantel Contractors' Association and as chairman for the Industry Research Bureau in 1934. His outstanding collection of old decorative tiles was donated to the Smithsonian Institution in Washington, D.C.

A kind note from the wife of former 1907 class secretary **Gardner Gould** was passed on to us from Fred Goldthwait, '05. Mrs. Gould states that Gardner has for several years now suffered from ill health, but is able to get up and around a bit. She adds that they celebrated their 62nd wedding anniversary last September and that their two children, six grandchildren and three great-grandchildren are all well and happy.

Mr. Goldthwait noted that as a result of persistent meetings with Gardner, Don Goss, '18, and George Smith, '26, they succeeded in establishing the basis for the M.I.T. Club of Boston. He also adds a cheery "Good job!" for the '07 news column—for which we say a cheery "Thanks!"—Kathy Sayre, Class Notes Editor, Technology Review, Room E19-430, M.I.T. Cambridge, Mass. 02139

08

Our 65th Reunion will be a Homecoming at Cambridge in June 1973. There are 74 of us left and at least 20 should be able to return to this coming reunion. **Karl R. Kennison** is back at Auburndale and will be our chairman. It will be interesting to notice the changes that have taken place since we moved to Cambridge.

We are sorry to learn of the death of another classmate Major **Eugene L. Brown, Jr.** of 2334 W. 241st, Lomita, Calif., on July 9, 1972.

Notes from Alumni Fund envelope flaps from **Roger C. Rice,** C. E., age 86 at 860 6th St., Los Banos, Calif. "Still employed with Central California Irrigation District as head of the Hydrographic Division. Also have complete observations of U.S. weather available if needed. I have been in Los Banos since 1929, first with Miller and Lux, then with C. C. Hindale."

Another from **John S. Barnes,** M. E., "No news is good news. At 85 I'm still enjoying good health and enjoying life. Living with my daughter here in Conn." . . . Another from **George D. Whittle,** C. E., "Sickness only—wait until I can report more hopefully." George is retired at 2550 Dana St., Berkeley, Calif.

The Alumni Office reports, they are sorry that Andrew D. Fuller of the Class of 1895, our oldest class secretary, passed away July 26, and a memorial service for him was held in the M.I.T. Chapel on August 3.

One of the nice things about M.I.T. is that they have local clubs of graduates in many localities. One of six such clubs in Florida is, the M.I.T. Club of Southwest Florida. My wife and I spend our winter months in a condominium in Venice, Fla., and I have been a member of this club for the past six years. You would be surprised to learn that there are over 100 M.I.T. graduates living in this area. We have dinner meetings in Sarasota. Of special interest was "The First Florida Festival" when the six Florida Clubs united at Orlando in January 1968 to hear Dr. James R. Killian, Jr., '26, Chairman of the M.I.T. Corporation and Gregory Smith, '30, Member of the Corporation.—**Joseph W. Wattles,** Secretary-Treasurer, 26 Bullard Rd., Weston, Mass. 02193

10

Attending Alumni Day, June 7, 1972, were the usual classmates that attend every year and their wives; George Lunt, Ralph Horne, Arthur Curtis, Murray Mellish, and Herbert Cleverdon.

I had a card from **Fred Lufkin** asking why I did not attend the Pops Concert this year as I did last year. He said he attended it and expected to see me. I did not attend, as my wife did not feel up to it. Fred did not attend anything but the Pops Concert. Several classmates have asked me if I knew how many men still survive in the 1910 Class. Having requested this information from the Alumni Office, I received a list of these names. The list shows 68 men still alive and I will try to get more information for the next issue.—**Herbert S. Cleverdon,** Secretary, 35 Windmere Rd., Wellesley Hills, Mass. 02181

11

The bad news first. The following was taken from the *Lynn* (Mass.) *Item* of last May 15: **"Philip L. Caldwell, Sr.,** 83, of 1612 Casey Key Rd., Nokomis, Fla., formerly of Lynn, retired executive, died Saturday at Venice Hospital, Venice, Fla., after a brief illness. Born in Lynn, he had resided for many years in Montville, Conn., where he was past vice president of the Robertson Paper Box Co. Mr. Caldwell, a graduate of M.I.T., Cambridge, moved to Florida 14 years ago. He leaves his wife, Barbara (Bullard) Caldwell; two sons, Philip L. Caldwell, Jr. of Port Chester, N.Y. and Robert L. Caldwell of Rochester, N.Y.; four grandchildren and two great-grandchildren." . . . I have to report one other death: **Henry Wood** of 62 Lloyd Ave., Providence, R.I., died May 17 of this year. I have no further information about him.

The following note came with General **George C. Kenney**'s contribution to the Alumni Fund: "On Oct. 25, 1971 I was married to Mrs. Jeannette C. Steklin of N. Miami, Fla., and am now living there. I have become a Floridian instead of a New Yorker and I like it. The weather is warmer and better."

I have received three other changes of address: Joseph N. French, 28536 Elmira St., Livonia, Mich; Harry E. Lake, 10023 Forresters Drive, Sun City, Ariz.; and Erving M. Young, The Ward Homestead, Elmwood and Boyden Aves., Maplewood, N.J.

Morris Omansky, Gertrude and **O. W. Stewart** and I attended the alumni Homecoming the first weekend in June. Morris had received a citation from the national rubber chemists association honoring him for his sixty years membership.

What **Frank Smith** of Honolulu reads

convinces him we are going through a period like 1927, '28 and '29 and are headed for a 1929-type crash. He is loading up with cash.—**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

Our class celebrated its 60th anniversary reunion from June 2-5 with headquarters at McCormick Hall on campus. We thank **Albion Davis,** our president and reunion chairman, who planned and directed all details. A total of 32 were present, of which 20 were men, with 10 wives, one widow and one guest.

Al Davis recently lost his wife, Gertrude, and has retired from his position as manager of Algonquin Club. . . . **Johnnie Noyes,** our estate secretary, who had just recovered from a heart attack, made the trip from Texas by car, although his grandson did most of the driving. And he left after the reunion for his usual summer home in Brooklin, Maine. You can't keep a good man down! . . . **Harold Brackett** and his niece, Eleanor Forbes, had already moved to their summer home in Limerick, Maine. They stopped at Marblehead on the way down and picked up **Jim Cook.** Jim is his same old jovial self and with his hearing aid, (a device which many others of us now favor) seems well able to hold his own. . . . **Larry Cummings** and Julie are both well and planned to spend part of the summer at Squam Lake, N.H. . . . **Jerry Hunsaker** is also in good health and was thinking about the fishing at Grand Lake, Maine where he goes each year. . . . **Harold Mitchell** and Mildred have mostly recovered from their illnesses and came on from Buffalo where Harold is still busy with bird conservation.

Harold Manning and Helen drove from Woodbury, Conn. where they have become accustomed to apartment life. . . . **Cy Springall** and Marjorie, though not too well, were with us as usual, and participated in the entire program. I do not think they have ever missed a reunion or alumni luncheon over the years. . . . **Willis Salisbury** again came all the way from Minneapolis to be with us. He is undoubtedly our greatest traveller and recently returned from Hawaii. . . . **Wallace Murray** had just returned from a long cruise in time to be with us. He is now living in Sebago, Maine. . . . **George Sprowls** of Akron, Ohio is another active class member, who still plays golf every week. . . . **Phil Dalrymple** and Helene have a summer home near Boothbay Harbor, Maine. Phil still works as a design engineer for Jackson and Moreland. He designed the moon landing module for the Apollo and from a photo, explained some of the special problems involved.

Ham Merrill and Phyllis have recently left Bridgeport, Conn., where they had lived many years, and now are located at Orleans, Mass., in the old family house where they were married. . . . **John Barry** and Ruth arrived a bit late due to other appointments. They are both in good health. . . . **Joe Champagne** and Libby, our dance professors, advise they have practically retired, though they are still in good shape. Joe is also a bit of a composer and after our class dinner, sang a Tech song he had written himself. . . . **Mac MacCormack** attended the class luncheon and says he has recently moved from Connecticut to Maryland and will probably go back to his native New Brunswick, Canada. . . . **Fred Busby** is in good health, but retired as a teacher last year, due largely to transportation problems. **George Brigham** and Irma arrived from Ann Arbor, Mich., where he is still active as an architect and presently interested in promoting a design for small homes. . . . And we were all most pleased to welcome **Dorothy Cremer,** widow of Randall Cremer, who had met **Jesse Hakes** and Mary as a passenger on their three months' cruise to the Orient.

Group of 1912 Class Members at their 60th Reunion: in front—Mrs. Wilson, Mrs. Manning, Jim Cook, Al Davis, and Mrs. Cremer; behind—Ray Wilson, Willis Salisbury, Wallace Murray, Harold Manning, Mrs. Springall, and Jonathan (Col. Sanders) Noyes

And now for the party and its activities! Some of us who arrived Friday morning attended the commencement exercises at which 1350 received diplomas, half of which were for advanced degrees. There were 49 women, a record. In 1912 there were 350, and only five received advanced degrees. In the evening, we assembled for cocktails and dinner, after which we gathered to visit and chat. **Ray Wilson** presented slides showing previous reunions and some made from portfolio photos. These began with the dedication ceremonies of the new Tech in Cambridge (1916), followed by those of the 1919 All Technology celebration by boat to Nantasket Beach with parades and stunts; then to Marblehead in 1927, Framingham in 1937, Mayflower Inn in 1932 and the three trips to Snow Inn in 1952, 1957 and 1962; then at McCormick Hall in 1965 and 1967. At our 50th (96 present), we also participated in the commencement exercises. There was considerable interest in attempting to identify different classmates from these old likenesses.

For Saturday luncheon, we drove out to the Tech Endicott House in Dedham, a large estate with beautiful gardens which was donated to Tech by the Endicotts of Binghamton, N.Y., and is now used to entertain special visitors, and occasionally for small special classes. We were delighted with the beautiful decorations and antique furniture as well as the rugs, paintings, gun exhibits and fishing tackle collections. Many of us roamed about the grounds and admired the flowers, as we exchanged memories of our days at Tech. We returned to a deluxe cocktail party in McCormick penthouse, with a view of Charles River Basin dotted with small racing sloops. After dinner we gathered in a private lounge to chat, and were entertained by **Johnnie Noyes** with an endless supply of stories, mostly of Texas.

Sunday, many of us renewed our acquaintance with the Tech buildings and visited the several fascinating displays about the campus, such as the Hayden Gallery. (I saw a photo of the original Tech site, a field of mud where I once labored as a surveyor for several months.) One group toured the famous glass museum at Harvard. The big event, our Class Dinner, was held in a private dining room at McCormick, followed with a brief address by our president, Albion Davis. Your secretary then read a number of letters received from members of the class who had decided not to attend, either due to poor health or because they were not up to a long trip and the many activities. We were then taken by bus to the Pops concert in Symphony Hall, a complete Tech sell-out, directed by Arthur Fiedler, which brought back old memories.

Monday was Homecoming Day and we attended at least some of the excellent lectures presented by distinguished speakers and built around the subject, "Major challenges of the next quarter century." Then the traditional class luncheon at Rockwell where we filled four tables. There was the presentation of gifts by the different classes and an address on education demands by our new president, Dr. Jerome B. Wiesner. We all buzzed about Rockwell Cage again

in the afternoon during the Social Hour, visiting also with many we knew in other classes. In the evening the Mannings showed some of their reunion slides and photos, after which it was time to say goodbye to all. Truly, a wonderful reunion for everyone. And we send our very best wishes to those who were unable to attend. We mailed a greeting card to **Jay Pratt,** our former assistant class secretary, and to his wife, Priscilla, which was signed by everyone present at the reunion. They had planned to be with us at the festivities but poor health forced them to cancel their plans. In his letter of acknowledgement, Jay wrote that they were much better and that he was putting in several hours a day in his garden. Priscilla is again able to resume her bi-weekly rounds of golf. We all send our best wishes that this will continue. . . . **Henry Babcock** and Ruth had hoped to attend the reunion but were unable to do so because of special work in his profession of consulting engineer in real estate and its valuation. The Babcocks have five daughters, 12 grandchildren, and two great-granddaughters all of whom they visit often. They plan to summer at the old homestead in Goshen, Mass., and ask any classmate passing nearby to visit. . . . **Cornelius Duyser** wrote that his health was not good enough for him to make the reunion trip, but sends his best wishes to all.

The following changes of address are included: Marcel DesLoge, 371 Rte. 2 Chesterfield, Mo. 63017; Charles D. MacCormack, 235 Woodridge Dr., Rte 7, Salisbury, Md. 21801; K. C. Robinson, 3830 Village Rd., Concord, Calif. 94520; Paul R. Lawrence, 316 Peebles St., Sewickley, Pa. 15143; Herbert H. Calvin, Vilestrada #114B, Laguna Hills, Calif. 92653; Henry C. Dunbar, Damascus, Va. 24236; Hamilton Merrill, Box 313, Orleans, Mass. 02653; Ora Merry, 4200 45th Ave., N. Robbinsdale, Minn. 55422; Alvin G. Thompson, 320 Friendship Manor, Roanoke, Va. 24012; L. B. Walker, 580 Long Hill Ave., Shelton, Conn. 06484.—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081

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Greetings and salutations for the year 1972-1973. Yes, the Homecoming Alumni Days for June 1972 have come and gone and the Alumni Association provided a very interesting, social and instructive program. The highlights were the buffet at the Student Center, Pops under the leadership of Arthur Fiedler (Charlotte Sage and the Capens enjoyed these two events with the Brewsters.) The Monday events were outstanding with several panels; the luncheon in Rockwell Cage, and there was a delightful gathering of the '13ers including our Vice President Charlotte Sage, Burton Cushing, Warren Glancy, Philip Terry, Henry and Jane Glidden, Walter Muther with his daughter and son-in-law, Sally and Edward Lawton. By a vote of those present it was suggested that 1913 hold its 60th reunion on campus. Many of the older classes are holding their reunions at the Institute due to the many interesting events and conveniences available. The transportation problems encountered nowadays by our "oldsters" can be solved by plane, auto, train, street-car or bus. We enjoyed several of our friends of other classes as Albion Davis, Ray Wilson, and others of the 60th Reunion group of 1912. Also, "Doc" Hamilton with his charming wife; Ray and Mrs. Dinsmore, Mr. and Mrs. Charles Chatfield, all of the Class 1914. The exhibition of restored old portraits, statues, and mementos of "Tech Life" from President William Barton Rogers through President Karl Taylor Compton administrations were delightful as well as nostalgic. The "party" and social hour were outstanding as usual. We greeted our new President, Jerome B. Wiesner, Paul E. Weamer '49 and his charming wife, Walter M. Saunders, '22, and many others. Again, an enjoyable informal dinner at the Student Center where we met several old and new friends of various classes.

We regret to announce that Dr. **Francis H. Achard**'s wife, Margaret (Mell) Richardson, Class of 1923 passed away May 23, 1972. We have extended to Frank the sincere sympathy of the Class of 1913. . . . We apologize to **Dave Stern** for not acknowledging his note of over a year ago (misplaced in moving to Maine), and we quote: "Sorry to learn from the class notes that you are about to leave Canton and become Maniacal in Biddeford. We hope you will have a pleasant and comfortable retirement in that nice town. That reduces the likelihood of Phil's making up at Boston Rotary. Will he be joining Biddeford Club? I am now treasurer of the Boston Club."

We are indebted to the Alumni Fund office for several notes. **Charles Albert Smith** prints: "No news in particular. Still married to same girl (55 years this November), two sons, two lovely sons' wives, five grandchildren, five great-grandchildren, all living within 50 miles. Have very little money, but are rich beyond words." . . . From **Howard S. Currier**: "The 1973 Class Reunion, now only a little over a year away, will not be so very interesting unless held at some nice spot on the Cape."

Edward M. Bridge writes, telling that he sent us a copy of his memoirs covering the 43 years of his architectural practice. Ed's "Story of my Life" was received and appeared in the June *Review*. . . . We are very much pleased for the short note from **Arthur E. Hirst**. We can sympathize with you, Arthur, and your dear wife as we are also experiencing the ailments of "old age," but hope by now that you both may enjoy many years of happiness. Arthur also sends his "best to all the '13 gang." . . . Mrs. Hilding N. Carlson (Ethel) new address is 25 Morton St., #301, Quincy, Mass. 02169.

The Capens expect to visit M.I.T. and confer with Don Severence and Fred Lehmann to ascertain more details regarding reunion plans, and you will receive further communications at a later date. It is suggested that you read the write-up on the various reunion classes in *Technology Review* for July-August Page 88. If you have any suggestions, write me.

That's it until December issue. Write us about your activities.—**George Philip Capen,** Secretary-Treasurer; **Rosalind R. Capen,** Assistant Secretary, Granite Point Road, Biddeford, Maine 04005

14

With our wives, Ray Dinsmore, Leicester Hamilton and I attended several of the events of Alumni Days in early June, and found them, as always, pleasant and interesting. We just wish that more of the class would come, especially those who live within easy reach of Cambridge.

In a letter late in April, **E. Mortimer Newlin** suggested that alumni consider setting up trusts for the benefit of the Institute, as he and a few others of our class have done. Mort mentioned that he is retired, and lives in North East Harbor, Maine, in the summer and in Bocagrande, Fla., in winter. He added that he has a lot of grandchildren, all of whom he sees in one place or another.

Ray MacCart wrote late in May that he and Virginia had returned to their Washington home, after spending four months in Florida enjoying the best winter in his memory. He said that, after long consideration, they had decided not to move to Florida permanently, but to continue dividing their year between their apartment in Washington and the one in Pompano Beach. Ray mentioned also that, as a 50-year member of the Army and Navy Club in Washington, he has been made a Knight of the Golden Circle.

When **Lester Forbes** kindly telephoned in July to tell me where I might write for information about a classmate who died several years ago, he mentioned that a good part of his career was with the Submarine Signal Corp., and included 13 years in Europe. That corporation was eventually merged into the Raytheon company, and Lester had a senior position in its New York office until his retirement. He has lived in New Rochelle, N.Y., for more than 25 years.

Frank E. Dunn died on June 12, 1972, at a hospital in the vicinity of his home in South Weymouth. He was born in Charlestown, Mass., in 1891 and went to schools in Revere and in Melrose. Frank was with us in all four of our undergraduate years and received his degree in civil engineering. His career in that profession included work in the construction of the New York subway system, and two years as resident engineer on a Cuban sugar plantation. In 1921 he was employed by the Underwriters' Bureau of New England as a fire-insurance engineer-inspector, and continued in that occupation with that organization and its successors until his retirement in 1958, when he was superintendent of inspections for the New England Fire Insurance Rating Association. Frank was a member of the Massachusetts Society of Mayflower Descendants, and was a life member of Wessagussett Lodge, A.F. and A.M. He leaves his wife, the former Susan Evelyn Greeley; a daughter, Mrs. Eugene H. Nellen of New York City; and three grandchildren. Most of what precedes was written by Frank himself after an illness about eight years ago, and was kindly sent me by Mrs. Dunn, to

whom I have extended the sympathy of the class.—**Charles H. Chatfield,** Secretary and Class Agent, 177 Steele Rd., West Hartford, Conn. 06119

15

Hello everybody! Here beginneth the first column of the new season, with the hope that you and your families have all enjoyed a pleasant and happy summer. Our Annual Class Cocktail party and dinner was as popular and successful as ever, with 38 for cocktails and 22 for dinner following. A "good show." The "younger members" of the Class and their families added a lot and were particularly welcome and we want them to join us every year. Barbara Thomas, really a part of the Class, with her friendly and personable presence added a great deal to the party and was a gracious hostess. The Pirate's nostalgic "we are happy" cheer inspired us all to enjoy a fine dinner. It was great to have Mary Scully with us. Many who could not attend had the interest to write their regrets. We missed them all: **Hank Marion** phoned from Oklahoma City and **Ben Neal** from Lockport, N.Y. Nice going! Several could not attend because of illness. The long distance men deserve special mention: **Alton Cook** from Bloomfield, N.J.; Bee and **Charlie Norton,** Martha's Vineyard; **Stan Osborn,** West Hartford, Conn; **Larry Quirk,** Middletown, Conn; **Jack Dalton** and **Pop Wood,** Peterboro, N.H.; and the winner—**Bob Wells** from Los Angeles and wonderful to see him again in good health. A fine crowd of good old friends.

We have a reading public in the alumni: Herb Larner, '17, wrote that he lived originally in Cambridge and knew that old Rindge Tech crowd—Eddie Fonseca, Weare Howlett, Wally Pike and Frank Scully. His niece married Bill McEwen's son—a small world! . . . Irving M. Dow, '30 wrote: "Today the *Technology Review* arrived and the first thing I did, as I usually do, is look for the class of 1915 to see whether you are still reporting the news for that class. What a job you have done! Everytime the *Review* has come out for some years I have intended to write, but always put off until the next issue and then other items pushed it back until forgotten—that is, the writing, not you." . . . Vi Proctor, widow of Dix Proctor, '17, wrote us about being at their 55th Reunion and Alumni Day. Good for her. . . . It's nice to hear from you readers and many thanks for writing.

It's wonderful how **Mary Plummer Rice** does get around. She commands our praise for her interest and work. From Paris, in July she wrote: "I've had such a happy three weeks with the U.S.O. Clubs in Keflavik, Iceland, Frankfurt and Paris. Many G.I.s and their families in Germany came to Frankfurt for the long weekend. The D.A.R. and American Legionaires were there for the ceremonies. I am going to London for two months." Wonderful, Mary, keep it up.

Ray Stringfield, Los Angeles, wrote to Ben Neal: "Sorry that Los Angeles is so far away from Cambridge that we can't make the class cocktail party June 5th. Our best regards to all the gang. I've finally retired from my two corporations, and am trying to take it easier, but the attorneys won't leave me alone and still keep asking me for reports on tire accident cases. Was in Sacramento for two days last week on a case where the defendants decided they didn't have a chance after listening to my testimony and cross-examining me for some time and settled it without letting it go to the jury.

"Lost 22 pounds from an infection in November, and have only gained four of them back, which is some improvement. Guess I'd better get another infection. Also had a cataract operation in December, which is no trouble these days, but the glasses I got with which I could read well at first are not so good now, so guess my eye is changing a little and will have to be checked again. Due to the smog, LA isn't as nice as it used to be, but isn't too bad. We get away to our cabin at Desert Hot Springs (across the valley from Palm Springs) when we can, and in the summer when it gets too hot, we go to Sunset Beach. The earthquake of last year damaged our chimney, but nothing serious. A lot of buildings are having to be reinforced, however. Well, hope you're taking it easy, and sure appreciate what you do for the class and M.I.T. Best regards."

A Concord, N.H., paper carried this splendid tribute to **Herbert D.** "Speed" **Swift** for his many generous, civic activities: "The Tracy Memorial Library observed its 75th anniversary with the dedication of its New Hampshire Room and the unveiling of a portrait of the man to whom the room is dedicated, the late Herbert Dyer Swift. Recently renovated, it was furnished by New London resident Maude E. Swift in memory of her husband. Mr. Swift was one of New London's most prominent residents during his 38 years of residence in the town. During this time, he was New London's delegate to two state Constitutional Conventions, representative to the General Court for four years and a state senator. He also accumulated a long list of service accomplishments on many of New London's civic organizations.

"In March 1916, he married the former Maude Fellows, a New London resident. Mr. Swift retired from M.I.T. in 1928 because of his increasing difficulty in hearing, and he and his wife then came to New London, where he spent the remainder of his life. For many years, he served as treasurer of Tracy Memorial Library and as president of the Board of Trustees of New London Hospital. Mr. Swift also founded and endowed the Heidelberg Prize Speaking Contest for the public schools. He was a former president of the New London Old Home Day Association, a charter member of the town's historical society, and active in local government. 'To the end of the days,' said Dr. Squires in his address, 'Herbert D. Swift devoted himself to his adopted town and to his state in a way and to a degree that made him one of New London's outstanding citizens of the 20th century'."

The sympathy of our Class goes to **Henry Daley** and his family (one of his sons, Henry Jr., is M.I.T. 1947) for the sad loss of his wife, Frances, who died July 4, after a long illness. With Henry she attended our Class Cocktail party and dinner here each year. We were always glad to see her and enjoyed having her with us and we'll miss her.

Ray Delano was laid up in the Jordan Hospital, Plymouth, Mass., with some surgery. Representatives of the Class, led by Larry Bailey went to see him and, I'm sure, cheered Ray on his way to a successful recovery. . . . You all keep well and write when you can—it helps Azel.—**Azel Mack,** Secretary, Apt. 26A, 100 Memorial Dr., Cambridge, Mass. 02142

16

Our report this month covers first of all the 56th reunion at Chatham Bars Inn, where we had the pleasure of sharing the time and place with our good New York monthly luncheon playmates, the somewhat-younger but well-behaved Class of 1917 on their 55th reunion. Gross attendance at our reunion was 42, with 35 at the clambake and sitting down for the banquet. Here's the list of those who were there: Mary and Joe Barker, Beatrice and Walt Binger, Jessie Brophy (a reunioner for many decades, for Steve Brophy officiated in the past as our five-year reunion chairman), Helen and Jack Burbank, Phyllis and Clint Carpenter, Hildegarde and Jap Carr and guest, Conny Fiske, Dina Coleman, Hope and Theron Curtis, Frances and Paul Duff, Jim Evans, Gladys and John Fairfield, Sibyl and Ralph Fletcher, Mertie and Allen Giles, Gretchen and John Gore, Maury Holland, Lois and Charlie Lawrance, Anne and Izzy Richmond, Francis and Henry Shepard, Gladys and Francis Stern, Dolly and Len Stone, Frieda and Hy Ullian, Nell and Don Webster, and our reunion-arranging honorary member Bob O'Brien and his charming wife Rose.

Our account of the reunion comes largely from the pen of our hard-working **Len Stone,** who prepared a bright account of the doings at Chatham before Dolly and he left for their summer island home on Little Beaver Island in Lake Winnepisaukee. Len's report is interlaced with items supplied by **John Fairfield, Clint Carpenter, Charlie Lawrance,** and **Bob O'Brien.** The earliest to arrive on Monday were the Stones by car from Jackson Heights, N.Y., and the Fletchers by plane, who landed in Falmouth because of the fog further out on the Cape. Tuesday started off this way, according to Len: "Chilly again and overcast which gave zest for breakfast and provided energy needed to get bulletin boards set up and to tack on class pictures, clippings of news of classmates, etc., collected by our secretary, **Harold Dodge,** during the year. The overflow required several binders, hence a trip to town and the best stationery store I've seen in years—a town full of interesting shops and bistros (Whatever they are!)." On returning they found Gretchen and **John Gore** from Canajoharie, and shortly after that Anne and **Izzy Richmond** drove in—by auto this time as the weather was too

The Class of 1916 at their 56th Reunion at Chatham Bars Inn, Chatham, Mass., June 6-8, 1972.

uncertain for Izzy to fly as is his custom. After lunch the influx began to thicken and chronology becomes confused. Soon Bob and Rose O'Brien drove up with the usual relief for those suffering from drought. This was only one of the many details handled with superb efficiency by our Honorary Member.

Writes Len: "Dinner was a gala occasion as always. All meals (except breakfasts) were spiced by Ralph's excellent wine—much appreciated by all. After dinner friendly musicians who have played for us for many reunions provided dance music of our vintage to the delight of all. Izzy Richmond's open stance style set a pace that the rest of us could not emulate, but we had a good time with more restrained gyrations!"

Wednesday was the day of major activities. The first order of business was a stag "bull session" which settled the affairs of the nation while the distaff side went shopping and exploring. The "bull session," said Virginian **Clint Carpenter,** "represented about the only serious moments of the reunion." The topics chosen, including busing, "proved to be a wise choice and developed . . . conclusions reflecting the knowledge and wisdom to be expected of '16ers."

And then came the time for libations and the famous shore dinner; weather was not too bad, but shelter was provided and all ate and ate and ate in comfort. Len reports the best darn steamed clams, lobster, corn on the cob, watermelon he ever did eat. Several managed two platters of clams and two lobsters (Cy Guething please note!) Don't know how they could do it! The taking of the class picture provided the outstanding group-comic-relief of the reunion—did you ever try to corral 40 chickens into formation and keep 'em quiet? Our old photographer friend of many such encounters, Howard Studios of Hyannis, finally achieved the impossible—then "Where's Izzy?" and "Where's Ralph?"—"Oh, no!" Then came time for naps, followed by the executive committee meeting at Ralph's cottage followed by the general class meeting in Cottage G. After expressions of disappointment by the class that more space is not available for class notes in *Technology Review,* a committee was appointed to send a letter urging, with cogent reasons, that more space rather than less be allowed. Other activities were initiated, and then the meeting dissolved rather than adjourned to prepare for the class cocktail party, which laid a gemutlich foundation for a very festive occasion. The girls put on their best bibs-and-tuckers and the boys, resplendent in red jackets, made a scene fit for a movie extravaganza. It was difficult to obey the summons of the dinner bell announcing the banquet, a truly marvelous one held in the main dining room with a horseshoe arrangement of tables to accommodate 35 people. The post-banquet festivities started with the President's welcome and the reports of the Treasurer and the Secretary. **Jim Evans** engineered signatures for birthday cards for those who could not attend but were celebrating elsewhere, as for example, Phil Baker and Cy Guething. A letter was also circulated for signatures—to **Dave Patten** who had just been taken to the Massachusetts General Hospital with a serious back injury as a result of a bad fall from a ladder. To close the meeting with a bang, Bob O'Brien had recruited our outstanding raconteurs for a few words appropriate to the occasion —**Dina Coleman, Paul Duff, Francis Stern, John Fairfield,** and **John Gore.**

On Thursday morning, cleaning up, packing, and farewells occupied the time and celebrants, mostly after lunch, left the premises again to the birds and the rabbits. The Gores stayed over until Friday, no doubt to allow John to check on some more bird calls and perhaps to rehearse the sound of departing automobiles. So ended reunion No. 56!

From Leonard Stone comes the following footnote to the reunion report: "On July 13 the committee, as instructed by the class, presented a handsome illuminated scroll to your Secretary, **Harold Dodge,** in appreciation for his devoted services to the class for lo these many years. The presentation was made at luncheon at a fine restaurant near Harold's home in New Jersey at which were gathered, beside the honored guest and his lady, Sibyl and Ralph Fletcher, Francis Stern—who arranged for the scroll, and Jimmy Evans. A check on the weather on that date, three inches of rain in New York, explains the absence of Mary and Jo Barker; Dolly and Len Stone were stymied in New Hampshire. To cap the climax of a festive week, Grace and Harold celebrated their 50th wedding anniversary two days later."

Joe Barker has retired again, this time from the inner circles of Trinity Parish in New York City. At a meeting of the vestry on May 1, Joe, as a member of the vestry since 1940 and a churchwarden since 1960, was given a calligraphic scroll as a token of appreciation for his long and varied service to the parish. He was originally called to the task of surveying the church's buildings to prepare them for the parish's 250th anniversary. Many things were accomplished during his 32 years on the vestry, including restoring the beauty of St. Paul's Chapel which was designed in the Christopher Wren school of architecture; in connection with this, he and Mary made an extended tour of Germany, Norway and France to see how war-damaged churches had been rebuilt.

Travelers this summer included **Rudi Gruber** to his native city of Frieburg, Mildred and **Art Shuey** to Puerto Rico, Grace and **Dan Comiskey** to Dublin, Gladys and **John Fairfield** to Portugal, and Virginia and **Joel Connolly** all over the Pacific and Indian Oceans. . . . **George Maverick** says he and Ruth missed particularly the clambake and lobsters by not joining the reunioners. Instead of cavorting on the Cape, they were anticipating the pleasure of having painters in to paint that part of the inside of their home that hadn't been refinished for 16 years. But all this was bearable and the rush was on because of their approaching 55th wedding anniversary in July. Congratulations to our Charlottesville, Va. contemporaries! We know what a 50th is like ever since mid-July but only Ruth and **Emory Kemp** can look back on a 55th. And Ada and **Kem Dean** joined the growing Golden Anniversary Club in June this year. How the numbers grow!

From the *Boston American Herald*

Traveler of July 29, we have this bit from Harold Bank's column: "Reunion a Blast —Scientist **Vannevar Bush** and political scientist John W. McCormack had read and heard about each other but hadn't seen each other in about 30 years until they sat down to highly edible edibles at Jimmy's Harbor Side the other day. Way back then, Bush walked into McCormack's Washington office and asked for help in getting a little money. 'Two billion dollars,' McCormack recalled promptly. It wasn't hard to forget a nice round sum like that. 'For the Manhattan Project,' Bush explained. The project built the atomic bomb." . . . Our only source of news in Indiana came across in July. A clipping with a picture of a smart-looking somebody said that **Ed Hanford** was selected Engineer of the Year by the Calumet Chapter of Indiana Society of Professional Engineers. Our congratulations, Ed! Further, says the caption: "Retired as plant engineer for Lever Brothers of Hammond, Hanford now works for a Hammond engineering and architectural firm."

We have word that all goes well with **Paul Austin** in San Francisco. . . . **Cy Guething** expands on the glory of the gardens and countryside in Birmingham, Mich.—never more beautiful, with the many inches of rain this year. He tells of the second planting of string beans with a total of "20 poles, so far" in early June and some 22 tomato plants. We only hope his crops look better than ours after more and more inches of rain. Our best crop turned out to be the blooms on the laurel and rhododendrons. But he sounds gustatorially expectant as he adds: "Gyps and I will be here for the fresh corn season and corn fritters—yum, yum!" . . . In June, **Ted Strieby,** who has as his constant companion a Labrador retriever, headed for Vermont from Millburn, N.J., for a week or two with his daughter and two teen-age grandsons. . . . Mary and **Bert Ellis** were the first to move into a newly built apartment house in Chagrin Falls, Ohio, which they like very much. Bert keeps active with golf, extensive reading and an occasional meeting of the Residents' Association. . . . An interesting account about life in New England way back in the 1890s, was sent to us by **Merrick Monroe** from their summer place in Harrison, Me. Inspired by stories of his wife Miriam's hard-working forbearers in this region of Maine, Merrick ends his commentary with "In those days, people knew what work was with a capital Wubble-you!"

We regret to report the death of **Duke Wellington** in New Haven on June 28 after an illness of about six months. He had retired as sanitary engineer with the New Haven Water Co. for 30 years. Duke was always one of our regulars at the five-year reunions, although he was unable to make the 55th last year. And now looking ahead, write a little but write often to your willing-to-work secretaries, wherever you are and whatever you're doing, just to help keep the little old column full and interesting.—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone,** Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11372

17

The special, extra issue of Reunion News, mailed in August, gave details of our 55th Year Gift and successful Reunion at Chatham Bars Inn. Unfortunately the red 1917 numerals on Brick Dunham's old, well preserved football sweater did not reproduce.

The response to the Reunion notices and subsequent letters supply quite a store of comment and news of a good number of our members and widows.

Whereas Pat and **Bob Erb** arrived at the Reunion from a cruise, others used it as a jumping off place. Several lingered on the Cape and en route home while the **Les Fords** took off for Montreal, western Canada, to Alaska, to Seattle and Portland where they saw brother Wendell, also 1917, and then home. Sammie and **Dick Lyons** went along the Maine coast and into the Canadian maritime provinces for a trip that Dick has written of most interestingly. It can be summed up by referring first to a good visit at M.I.T. with the Administrative Officer of the Earth and Planetary Sciences, then to Mt. Desert Island and Bar Harbor, the area of the old summer camp at Machias, Halifax and Cape Breton Island, particularly the Keltic Lodge and the Cabot Trail. He concludes with, "For people who live on the flat Texas Gulf coast, and who do not normally experience the scenery and the deep blue, cold waters such as exist in Eastern Canada, the trip was most rewarding."

Some old regulars were missed at the 55th. It cannot be recalled when **Connie Coakley** missed a five-year reunion but he couldn't make it this time. **Al Moody** regains his health but had to miss this one. Another regular was **Jim Ferrall** whose recent surgery prevented. Another was **Rene Pouchain** along with **Al Ferretti** who had to cancel. **Cy Medding** used the term "unglued" to explain why he and Elizabeth couldn't attend the reunion. That term applied also to Martha and **Dick Catlett** and Allene and **Noah Gokey.** The **Walt Whitmans** stay glued to the "Valley of the Sun" at Scottsdale but sent their regards to all.

Frank McKone gave an interesting report from Dover, N.H., where he lives with a son and is limited in travel to "the barber's every two months." A grandson got his doctorate from M.I.T. this year in chemistry and his younger son was raised to a judgeship by Gov. Reagan in California.

Tom Ryan has a second pin in his left hip replacing one that slipped. However he is feeling fine but in limited activity. He continues with his home building business in Ferguson, Mo., to his satisfaction. . . . **Bill McAdams** was recently elected a Fellow of the American Institute of Chemical Engineers. Wintering at Palm Beach he celebrated his 80th birthday, enjoys his swims and his 12 grandchildren.

Unfortunately space does not permit quoting an interesting, lengthy letter with pictures from **Vincente Checa** of Lima, Peru. His enthusiasm for the future of his country is limitless. Again he invites us to hold a reunion there assuring a most interesting time. A copy of his letter will be sent to anyone requesting it from your secretary.

Charlie Abels recalled his lowly state as a "Crusader" in the 1916 pageant and sent greetings as did Sam Creighton, Vinc Panettiere, Ray Blanchard, Elmer Joslin, Howard Mann, Stan Krug, Dave Waite, Carle Adams, Bill Sullivan, Leon Keach and Don Tarpley.

Hurricane Agnes didn't damage **Bill Dennen's** Pennsylvania farm but nearby damage was "unbelievable unless you saw it." . . . **Enos Curtin** and **Tom Meloy** intended to get to the reunion but had to cancel and like **Ras Senter** substituted their presence by substantial donations to the Buzz Aldrin Fund. . . . **Warren Tapley** is home from the Cape Cod Hospital recuperating well and **Brick Dunham** is back to normal after surgery. In spite of the reported ills of many of our members it would seem that we are in pretty good shape considering the condition we are in.

Those who visited the Northfield Mountain Pumped Storage Project will be interested to know that a carelessly left-open valve in the cavernous control area caused complete flooding, doing $50,000 damage and postponing operation until December. It is hoped that none of **Frank Peacock's** equipment was involved.

Regretfully the deaths of **George A. Nelson** in New York City and **Joshua C. Whetzel** in Pittsburgh are recorded.—**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard,** Assistant Secretary, 21 East 87th St., New York, N.Y. 10018

18

You probably got the message from the previous two issues that your Secretary and Better Half were to be in Yugoslavia during May—perhaps you expected to have a story about the spectacular sights to be seen in that country. Actually, there is little to report. We left Boston May 4, arrived in Zurich May 5, and returned to Boston May 6 to face an operation for the removal of the prostate gland which took place May 11. Surely this was the shortest "pleasure trip" on record. Fortunately, all went well, the recovery was rapid, and we were able to participate in the Alumni Homecoming in Cambridge June 4 and 5. My thanks to capable **Len Levine,** who did such an excellent job for this column for the previous issue.

The usual attendees for the Alumni festivities included the Kilduffs, Brosnahans, Grossmans, Chamberlains, Fletchers, Seltzers, Howes and Eli Berman. We were happy to meet the former Hazel Carey, who became Mrs. Saxton Fletcher on March 11, 1972. Sax reports his son has become assistant editor of the *Springfield Union,* Springfield, Mass.

Tom Brosnahan—though technically retired—does continuous research on "Mass. Retailers". His latest contribution is a two-page spread in the June issue of *The Merchandiser.*

Betty and **Jack Poteat** were able to do what we failed to accomplish. Here is their most interesting account: "Just back

Members of the Class of 1918 gather to discuss plans for their 55th Reunion. Top left standing: Max Seltzer, Charles Watt, and Eli Berman; seated: John Kilduff, Herbert McNary, and Julian Howe.

Samuel Chamberlain, '18, receives a Special Award for "outstanding achievement in support of historic preservation" from Miss Helen Hayes on behalf of the National Trust for Historic Preservation.

from an eight-week trip that took us to seven Iron Curtain capitals as well as Austria and England. Prague was dour and seemed repressed. Warsaw was bouncing . . . architects' drawings of the city show it to be restored like it was; it is a sheer joy and fascination. Changes in Russia since our visit in 1966 are evident: more automobiles and traffic jams; people are better dressed; new and better hotels and more drunks on the streets. When I asked the moderator in a dialogue session, if they had an alcoholism problem, he said, 'No, it is excessive drinking we have to deal with.'

"Then Budapest, Vienna, and Innsbruck where we celebrated our 52nd anniversary—the high point being lunch at 7,000 feet reached by cable car and gondola. Then two weeks in England . . . where roses were everywhere and the innate courtesy of the English was equally ubiquitous. Then, back to Philadelphia and a day with our son and his identical twin sons, age 5½. Home and the good old U.S.A. looked mighty good, after what we had experienced elsewhere."

The following appeared in the *Salem Evening News* and features **Sam Chamberlain** on the occasion of his receiving a national award. Congratulations, Sam! "Samuel Chamberlain, artist-photographer of Marblehead, received a Special Award for 'outstanding achievement in support of historic preservation' from actress Helen Hayes on behalf of the National Trust for Historic Preservation. The presentation took place in the newly designed garden of Decatur House, the Washington, D.C. headquarters of the National Trust. James Biddle, trust president, cited Chamberlain for his 'skill and artistry as a photographer, etcher and writer with which he has awakened in countless Americans an appreciation of historic structures in their natural settings.' The award consists of a piece of American rock crystal mounted in silver on a wooden base, symbolizing our natural and man-made environment."

We also have a news item concerning **John Norton.** According to the *Boston Globe* for July 29, "Dr. John T. Norton, professor emeritus in the Metal Physics Department at Massachusetts Institute of Technology, has been elected chairman of the board of Advanced Metals Research Corp., Burlington."

Congratulations to Marguerite Wills on the marriage of her granddaughter, Cynthia Wills, to Lewis Harriman. The wedding most properly took place in the Centre Congregational Church in Lynnfield, Mass., which was designed by our own **Bill Wills.**

By the time you read these notes you will have received your invitation to our third fall Mini-Reunion on October 22 at Endicott House, Dedham, Mass. We look forward to a big turnout to this gala event. This year we will be joined by the Classes of 1917 and 1919—the first joint effort by the three of us. Paul Gray, Chancellor of M.I.T., will be the guest speaker. This occasion promises to be one of the most exciting and rewarding on our calendar—one that you should not miss. If you have not made your reservations—do so at once to me. Remember—a Mini-Reunion gives maximum pleasure.

A 55th Reunion is once in a lifetime. We want to make ours a most memorable event with everyone participating. So reserve the time now for June 1 thru June 4. Make your plans to be here—and let's make it a ball! Planning is already underway. (see photo)

It is with great sadness that I record the death of **George Ekwall.** It had been my privilege to have had close contact with George, not only during undergraduate days, but also during the many years since then. He felt the call to do something important for humanity—joined the clergy about ten years after graduation—a vocation in which he contributed so generously of his talents to his flock. He was a most faithful member of the Class. We shall miss him.

The following are changes in addresses: Sidney B. Blaisdell, 90 Overhill Rd., East Greenwich, R.I. 02818; John W. Damon, Boot Pond Rd. RFD #4, Plymouth, Mass. 02360; Frederick M. Estes, Portland Rd., No. Berwick, Me. 03906; Ralph G. Mahony, Worcester Rd., Sterling, Mass. 01564.—**Max Seltzer,** Secretary, 60 Longwood, Ave., Brookline, Mass. 02146; **Leonard Levine,** Assistant Secretary, 519 Washington St., Apt. 15, Brookline, Mass. 02146

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Mary sent the sad news of the death of her husband **Arklay S. Richards** on Friday, June 30 at his summer home in Harwich. He was president of Arklay S. Richards Co., an engineering firm he founded in 1938, which specialized in temperature measurement and control. Arklay played tennis and was a member of the Longwood Cricket Club, the Badminton and Tennis Club and the Windsor Club. Your secretary would see him in Florida where he went to Silver Thatch Inn, Pompano Beach, Fla., for his winter tennis. He left three children and eight grandchildren. His home was 51 Caroline Park, Waban, Mass.

Edward C. Anderson has reported his address as P.O. Box 1459, 913 E. Main St., Richmond, Va. . . . **Lloyd R. Sorenson** now lives at 111 Waterview Rd., Yorktown, Va.

The Alumni Association reports the death of **George A. Inglis,** 2003 Greenbriar Bldg. A, Clearwater, Fla., on March 12, 1965.

Your secretary came north in June on the auto train and will return in October by the same route after spending time in Rockville, Md., Chautauqua, N.Y., Chalk River, Ontario, Canada, Portland, Maine, Boston, Mass., and Scarsdale, N.Y.—**E. R. Smoley,** Secretary, Apt. 11-E, 50 East Rd., Delray Beach, Fla. 33444

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Alumni Day seems a long time back but this is the first opportunity to report on those present from our doughty Class. Marie and Frank Bradley, Beth and Ed Ryer, Ruth and El Wason, Betty and Al Burke, Mina and Perk Bugbee, Al Wason,

Dave Fiske, Al Fraser, Frank Maconi and Dorothea Rathbone were there to make the gathering extra pleasant and rewarding for Amy and your secretary.

As mentioned, Betty and **Norrie Abbott** were traveling the rails in far off Scandinavia. A card from Norrie, mailed from the island of Gotland in the Baltic Sea, expresses regret at missing the Day and the pious hope that the floods didn't cause the Charles to overflow its banks and submerge the Great Court.

We were told by Al Fraser and Frank Maconi that **Will Hooper** had died last October. Will lived in Wellesley and had attended our 50th. A well known and well liked member of our Class, his loss will be keenly felt by us all.

Unable to be present on account of ill health were **Bob Patterson** and **Al Glassett**. We missed them and earnestly wish them a speedy and complete recovery. Bob lives at 54 Fayette St., Boston, and Al at 111 No. Pompano Beach Blvd., Pompano Beach, Fla.

A chat with **Frank Bradley,** by the way, disclosed that he still enjoys working as assistant engineering manager at Stone and Webster. Frank, holds the record, I am sure, for most grandchildren in the Class, no less than 21, plus four great-grandchildren. Let's hear anyone top that!

A cheerful note from **Skeetz Brown** of Scottsdale, Ariz., says that this eldest granddaughter, Marleen, of Salt Lake City, a graduate in sociology at University of San Diego, was married in La Jolla, Calif., and is going with her husband to Ethiopia for the Peace Corps. Skeetz says that he and Margaret have frequent reunions with Page and **Herb Fales,** Helen and **Charlie Klingler** and Clothilde and **Dusty Miller**—all "vigorous and volatile representatives of 1920."

In the last issue of the *Review* we reported that **Bob Tirrell** had moved from Englewood to Lebanon, N.H. We now learn with pleasure that Bob has remarried. His wife is Mrs. Eleanor Cummings who graduated from Wellesley in 1920.

Visiting **Buzz Burroughs** the other day, I learned for the first time the reason why our popular classmate, **Tony Anable,** was not among those present at our 50th. It seems that at that very moment his wife, Gloria, was the recipient of a "Distinguished Alumna Award" from Connecticut College. Those of us who have the good fortune to be acquainted with Gloria need not be reminded of her illustrious career as a zoologist, naturalist and conservationist. This citation is primarily for her contributions to the Mianns River Gorge, Wildlife Refuge and Botanical Reserve project near Bedford, N.Y. and Greenwich and Stamford, Conn. From her farm home at 219 Old Long Ridge Rd., in Stamford, dating back to revolutionary times, Gloria directs this outstandingly successful conservation project which has been named a Natural History Landmark by the U.S. Department of the Interior. The Anables are largely responsible for this achievement, all of which has been accomplished with private donations, effecting a saving in perpetuity of some 277 acres of forest.

From Bangkok, Thailand, comes an interesting letter from **Harry Kahn,** now on assignment for the International Engineering Society to lend his vast expertise to a local manufacturer of dinnerware and tile. Harry and Hannah left their home in Uxbridge, Mass., stopping at Copenhagen and then on to Bangkok which he describes as a very beautiful and exotic city but pretty hot. The city has its share of M.I.T. men, says Harry, but working six days a week and driving 25 miles to work has kept him too busy to look them up. He thinks the King of Thailand has a daughter at M.I.T.

Another distinguished ceramic engineer is **Henry H. Blau** of Columbus, Ohio. Henry has recently been made an Honorary Life Member of the American Ceramic Society, the highest honor accorded by the society. He is professor emeritus of glass science at Ohio State University and was associated with Macbeth-Evans Glass Co. and Corning Glass Works for many years before joining Federal Glass Co. Where he became vice president and director.

Lauren Hitchcock has been appointed director of development for Ecology and Environment, Inc., of Cheektowaga, N.Y. Dr. Hitchcock is considered a world authority in the field of air pollution as a result of his pioneering work as president of the Los Angeles Air Pollution Foundation. He is chairman of the Technical Advisory Committee on Air Pollution, Erie County Health Department.

Recent address changes include Bob Sjostrom who may be reached at Box 1543, Boca Raton, Fla.; Richard Soderberg, Box 23, Nantucket, Mass.; Julius Wolozin, 200 Mountain Ave., Malden, Mass.; Dr. Carl H. Leander, 44 Common St., Braintree, Mass.

Our distinguished classmate, **Irwin L. Moore,** has passed away. He lived at 470 Quinobequin Rd., Waban, Mass., and was long a chief executive officer of the New England Electrical System, continuing after retirement as a director until a few months ago. His interest in broadening New England's industrial base led him to form the Massachusetts Business Development Corp. He served as a director of the First National Bank of Boston, Berkshire Hathaway, Inc. and Yankee Atomic Electric Co. and trustee of Northeastern University. He leaves his wife, Cecelia, and two sons.

We have just received word that another member of our class, Brigadier General **Robert H. Van Valkenburg,** died earlier this year. He had retired to San Francisco and had moved to Nashville, Tenn., address 2009 Priest Rd.—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

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The 55th reunion of our class will be held at Wentworth-by-the-Sea, Portsmouth, N.H., from Friday, May 28 to Sunday, May 30, 1976. The reunion committee had a brief meeting at Cambridge on June 4 at which Reunion Co-Chairmen **Ted Steffian** and **Ed Dubé** presented a review of their investigation of possible reunion locations and their recommendation. This recommendation was accepted unanimously. Golf, tennis, heated swimming pool, clambakes, tours of Strawbery Banke, Portsmouth Naval Shipyard, and the Isles of Shoals are among the attractions offered at Wentworth-by-the-Sea.

Also at the June 4 meeting, **Al Lloyd,** Interim Reunion Chairman, discussed date and place for an interim reunion. The possibility of a Florida reunion next March, at the end of which classmates would fly to Mexico to attend the 25th Fiesta, was reviewed. Plans are not far enough along to reserve a block of rooms in a Florida hotel for next March, so that 1974 is probably a better bet for that. A number of couples including the Irv Jakobsons, the Lloyds, the Bob Millers and the Royal Woods are interested in the 25th Fiesta in Mexico. Consequently, it is proposed to make this another interim reunion for our class. Write Leon A. Lloyd at 35 Spruce St., Westerly, R.I. 02891 and get on his mailing list for another wonderful 1921 get-together in Mexico on March 15, 16, and 17, 1973.

Considering the magnificent turnout at our big reunion a year ago, a goodly number of loyal '21ers showed up for Alumni Day this year. Included were Adolph Aronson, George Chutter, Edouard Dubé, Edwin Delany, Robert Haskel, Sumner Hayward, Irving Jakobson, Melvin Jenney, Leon Lloyd, Richard McKay, Robert Miller, Donald Morse, Philip Nelles, Eric Smith, Edwin Steffian, Joseph Wenick and Royal Wood. Many of the wives attended also and added to the festivity of the occasion. An excellent program, delicious luncheon, and good fellowship made this a memorable day. News gleanings: **Bob Haskel** is still working five days a week in the company he founded, Standard Chemicals, Inc., a water-treatment concern. He and Laura have a cottage in Dennisport so Bob spends summer weekends on Cape Cod. . . . **Adolph Aronson** of Roslyn Heights, N.Y., attended his first Alumni Day since graduation from M.I.T., but hopefully not his last. He is still working in the textile promotional field. It was your Secretary's pleasure to sit next to him and Mrs. Aronson at Pops. . . . **Phil Nelles** reported that his wife Catharine had recently broken her arm and consequently felt unable to attend Alumni Day luncheon with him. Here's hoping she is well again. . . . Another who had planned to come to Pops was **Edward Haywood** of Melrose, Mass. He was stalled in traffic caused by road flooding from heavy rain that night and disappointedly turned back home. He writes that his daughter Edith is doing orthopedic research and has co-authored a number of papers on the subject. For recreation, Eddie likes to play golf, volley ball and poker. Penny ante?

Sadly we record the deaths of six classmates reported since our last deadline in May: **Edward S. Brown** of Danvers, Mass.; **Vernon C. Cole** of Prospect, Conn.; **Harold A. Greenwald** of Los Angeles, Calif.; Rear Admiral **Norborne L. Rawlings** of Newport News, Va.; **Saul M. Silverstein** of Columbia, Conn., and **Lyall L. Stuart** of Garrison, N.Y. Mrs. Cole wrote that Vernon belonged to Masonic orders

in Norwich, Conn., and Ft. Meyers, Fla., and that they had wintered in Punta Gorda, Fla., since 1963. . . . A nice note from Mrs. Greenwald mentioned that Harold had 90 patents to his credit and "loved M.I.T. and all it stands for." . . . Death came to Saul Silverstein on May 15 in Tanzania, Africa, while he was on Safari #34, which was also his tenth trip around the world. The pace that Saul led on his many trips was unbelievable and sounded exhausting to your Secretary. His most interesting accounts were perceptive and could well be used as a guide to anyone planning travels abroad. His last trip was to have included the Azores, Africa, Israel, India, Japan and Alaska. Travel frustrations including missed plane connections, poor food, heat and noise, appeared to be greater than normal. The *Manchester Evening Herald* cited his many contributions to civic planning, his church, management seminars around the world, and the Rogers Corporation. His many contributions to '21 class notes will be missed.

Joe Wenick of Caldwell, N.J., and his wife Dorothy had two thrills this past spring. Their son Martin, Second Secretary and Political Attaché at the American embassy in Moscow, phoned on Mother's Day to wish Dorothy "all the best." Then watching President Nixon's arrival in Moscow on TV, they spotted Martin in the welcoming group at the airport and later on inside the embassy. Martin lectures occasionally to American tourists in Moscow and was involved in arrangements for the Nixon trip. Joe continues to take occasional consulting jobs in northern New Jersey. . . . The **Carole Clarke** Clipping Service of Brielle, N.J., mailed two news accounts: (1) from the *St. Petersburg Times* concerning Cincinnati industrialist **Oliver L. Bardes'** $1,000,000 expansion of the Bardmoor clubhouse in Largo, Fla., and his plans for building many additional houses and condominiums around the golf courses; and (2) a photograph from the *Asbury Park Evening Press* showing **Munroe C. Hawes** receiving a past president's pin at the 50th anniversary of the founding of the Manasquan River Golf Club.

Submitted by **Al Lloyd,** the following is a footnote to the '21 class notes: Through his daughter Barbara, a Simmons College grad, Al "learned of a recent honor bestowed on Elizabeth McCoy Hayward, Class of 1923, Simmons College, and wife of our good Class Secretary, **Sumner Hayward."** The award given to Betty was the Simmons' Alumnae Service Award which citation reads: "Elizabeth, a noted writer and genealogist, has been a loyal member of the Class of 1923, serving as its President and later compiling and editing its 15th Reunion Book. She has served the Alumnae Association in many capacities . . . and has kept the spirit of Simmons alive in New Jersey through her dedicated work in the Simmons Club of New Jersey." The citation goes on to mention Betty's many civic activities and her extensive research work in the field of genealogy.

Correspondence

Doane Greene of Rock Hall, Md., mailed a snapshot of his "secret weapon against the ravages of old age", a beautiful new sailboat with cruising accommodations added. He entered sailboat racing in 1966 and is now hooked. "In my Columbia Sabre, I take great delight in sliding past my former competitors in their Rainbows. My health is excellent and barring accidents, I should live to 110." . . . Madeline and **Ralph M. Shaw, Jr.,** of Beverly, N.J., gave a cocktail and dinner party to 101 guests at their home on June 18, to celebrate their 45th wedding anniversary. Among their guests were Betty and **Dugald C. Jackson, Jr.,** of Havre de Grace, Md.

Edward W. Booth of Boca Raton, Fla., wrote to assistant Secretary **Josh Crosby** and also to your scribe, noting that with all the '21ers now living or wintering in Florida, he thought it would be nice to have a get-together in the state next winter. Maybe we can. "Scripps" continues active in accounting work. He and his wife spend their summers at Lake George, N.Y., to escape the Florida heat. . . . In the letter forwarding the Booth suggestion, Josh reported a nice evening of bridge at their house with Millie and **Herb Kaufmann,** who live on Siesta Key. The Key took quite a battering from Hurricane Agnes. The Crosbys spent the summer at Brooklin, Maine.

John T. Rule, former Dean of Students, wrote from Santa Fe, N.M., that he took on student advisory jobs at the College of Santa Fe and at St. John's College, following retirement in 1966 at M.I.T. He was Acting Dean at St. John's. Says John, "We suffer badly from pernicious nomadism and have been trying indulgence as a cure. This seems to be the characteristic disease of the old and retired—much more vicious than checkers and park benches." Janet and he hope to visit Spain and Portugal this winter, with a stay in London next spring.

Williston Wirt of Claremont, Calif., mailed a clipping from the June 3 *Los Angeles Times* relating that the oratorio "What Is Man?" would be sung the following Sunday at the First Baptist Church. Music is by the late **Samuel H. Miller,** Dean of the Harvard Divinity School. Will wrote that he is qualifying to drive a bookmobile for the Pomona Public Library—a "great end, as truck driver, after my M.I.T. training."

Samuel Lunden, Assistant Secretary, continues to be a real help in digging out '21 news, and has forwarded several letters. **Richard Morris** of Santa Monica, Calif., described a trip he and his wife took last December to visit a daughter in Mexico City. They also spent time in Guadalajara, Puerto Vallarta and Mazatlan. In the 1920s Dick sold two diesel engines to the city water works in Mazatlan and was amazed to see the change from a rural village to the fine tourist center of today. After Mexico, the Morrises spent three weeks in Arizona where Dick worked years ago for the United Verde Copper Co. A visit to Lake Powell behind the new Glen Canyon dam brought forth the comment "difficult to comprehend how one can get off a boat near Rainbow Bridge when formerly it was a 10-day trip by horseback. Arizona remains one of our favorite states." . . . **Edward Chilcott** of Hollywood, Calif., wrote that he sold the Techno Instrument Co. the J. L. Davidson Co., and Technical Products Co. during the last two years, but is as busy as ever with his cattle ranches and dairy. They own a Dodge Motor Home Bus and take trips around the western U.S.A. and Canada. Our 50th reunion is still a fond memory in Ed's mind and he expressed thanks to George Chutter and the many others involved. . . . **Sam Lunden** told of his and Leila's cruise to Skagway, Alaska this summer. As it was their fifth cruise on the Princess Lines, the captain presented them with an "Honorary Admiral" certificate stating "you have officially earned the degree of O.S. (Old Salt), O.O. (Ocean Oggler), W.W. (Wave Watcher), and S.W. (Ship's Wheel). You are hereby authorized to steer any row boat, paddle boat, canoe, surfboard or raft in, on, and out of all harbors, bays and puddles." Sam Leila no doubt tried this out at Cap Cod in late summer.

A number of news items on the back panels of Alumni Fund envelops will be covered in the next issue. Have a wonderful Fall!—**Sumner Hayward,** Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby,** Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; **Samuel E. Lunden,** Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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Under sunny skies and controlled by months of planning and arranging by our classmates and M.I.T.'s Alumni Association, our 50th Reunion became a more enjoyable and interesting experience than anyone had expected, even in their fondest dreams. Our president **Parke Appel** again thoughtfully provided a series of events which were so carefully organized as to timetable and costume that we decided it was the best ever. The frosting on the cake included the '22 berets, special beaver ties from England, gifts, souvenirs and prizes to make these memorable days convenient and happy from breakfast-tray time to final reminiscences in the late evening. Madeline and Park have been reassured of the Reunion success by the letters received thanking them for their tremendous efforts made for our comfort and convenience. The Appels wish to thank the class participants for their gift toward a trip to Spain this coming year. They have also bought a winter condominium, address Harbour House #404, 1000 Tarpon Center Drive, Venice, Fla. 33595.

We were happy to have with us on many occasions during the Reunion, Chairman and Mrs. Howard Johnson, President and Mrs. Jerome B. Wiesner and Chancellor and Mrs. Paul E. Gray. By the way, Paul expressed his pleasure in spending time with members of the class and sends regards from Priscilla to her many new friends.

We have heard from **Horace W.** (Mac) **McCurdy** telling of a second Golden Wedding Anniversary party given by some 260 friends and relatives in Seattle. They

The official picture of the Class of 1922 shows all the faces—but none of the fun —of the 50th reunion. The small pictures attempt the latter: a reunion of three co-eds—Marjorie Pierce, Martha Munzer, and Florence Stiles; Fearing Pratt, Raymond Miskelly, and Warren T. Ferguson at the Alumni Day cocktail party; the President's table at the Alumni Day luncheon; an old timers' circle at the cocktail party; and Norman J. Green helped into his unaccustomed academic finery before Commencement.

came from Philadelphia, Cleveland, Washington, D.C., Los Angeles, San Francisco, Portland and Vancouver. Catherine and Mac then left on a short cruise for their own private celebration.

The program of the Reunion and the list of those attending has been sent to our classmates, but here are some of the highlights and bits of news. Red coats and berets were the continuous costume with the berets presenting a special splash of color in the academic procession and on the platform at graduation. We were happy to advise many of the diploma recipients to "switch your tassel!" The class picture on Kresge steps was nicely done and Dorothy's Instamatic gave the Fergusons some colored pictures. The pleasure of class movies on Friday afternoon in Kresge, thanks to the late Clayton Grover, gave us a movie film record of the five-year Reunions. The later movies were made by that sterling and devoted trio of movie makers **Fearing Pratt, Win Potter** and **Oscar Horovitz.** Oscar did the final editing showing our 25th Reunion (1927), our 40th (1962) and our 45th (1967). Be with us to see the latest at our 55th in 1977.

We especially enjoyed the informal reception on Friday evening with the top M.I.T. people plus Dr. and Mrs. James R. Killian, Jr., Dr. and Mrs. John Wulff and Dr. and Mrs. Roy Lamson, our new Class professor. The Saturday bus ride and beautiful sunny day at Hotel Wentworth on the New Hampshire shore was crowned at noon by a New England shore dinner consisting of lobster, corn and all the trimmings. At the picnic tables, the McCurdys were given a 50th Anniversary cake, a song and a gold pin. Several of our greater athletes played golf and tennis, but porch-sitting proved most popular. Back at McCormick Hall that evening we listened to class news and reelected all officers.

The outstanding event Sunday was the impressive christening of the eight-oar racing shell "Catherine McCurdy" in the M.I.T. boat house with the assistance of Kate and Mac and the crew. Then the reception for the class at President Wiesner's home on Memorial Drive and the slightly rainy bus trip to Symphony Hall to see Arthur Fiedler in his red coat lead the Boston Pops while we sat at prominent tables on the main floor. Fiedler wore our 1922 beret during the inspired singing of "Sons of M.I.T." It was a real thrill to attend this enjoyable musical evening.

Alumni Day on Monday included the usual interesting and instructive program as listed in the Alumni Day brochure. Our special responsibility was the Memorial Service for all M.I.T. Alumni. Members of the class of 1922 including Parke Appel, William Mueser, Francis Kurtz, Everett Vilett and Whitworth Ferguson read the Litany of Remembrance and Confession with responses by the congregation. The service was written and conducted by Dr. Lester Clark Lewis and Rev. Theodore Strong Wray. It was a most impressive service in the M.I.T. Chapel honoring those deceased alumni

of the past year. These included twenty-eight from the class of 1922. The booklet for the Memorial provided the order of service, the two songs, the Litany and Eulogy and the Prayers. John Cook was the organist.

The Monday evening buffet in the Student Center was somewhat anti-climactic but still enjoyed by the 50 or so classmates remaining after the general cocktail party in Dupont Center. Then came the final evening of visiting, packing and returning to New York, California, Florida and Maine, after again voting our thanks to Parke Appel and his helpers from the class and the Institute. The final gesture of a gift to the Appels was spontaneous and gratifying. Martin Phillips helped us gather signatures of the class to be used for it. Many more details of our class reunion and the general program were in the July/August *Technology Review*, pages 85 to 90 inclusive.

Among our notes we find the prize winners for Bridge on Thursday night June 1, were Frank Kurtz, Helen Lewis, Lester Lewis and Madeline Appel. Hugh Shirey won the golf prize; Frank Kurtz the prize for tennis singles and Ted Reigel and Ray Ellis for doubles. Bingo prizes on Friday were awarded to Marion Greene, Hannah Abrams, Helen Ash, Elmer Sanborn, Ella Cummings and Karl Swett.

Several interesting facts were brought out by Dr. Edward W. Bowles at the class meeting on Friday night reminiscing about our senior year at M.I.T. and about Professors D. C. Jackson, Laws, Hudson, Bush and before that President McLauren. We will continue to review our notes for items of interest during coming months and incorporate them in the *Review*.

Our current items include a note from **W. Barton Jones** of Monterey Park, Calif., who retired as president and chairman of Barton Instrument Corp., when it was sold to I.T.T. five years ago. He is active managing cattle ranches and entertaining seven grandchildren. He is a trustee of Claremont Men's College, a member of the Board of Caltech Associates and an honorary member of the Instrument Society of America. . . . **C. Randolph Myer, Jr.,** is president and general manager of Souhegan Wood Products Corp., of New Hampshire and president of the Wilton Center Tennis Club. His activities include tennis, gardening, skiing and helping maintain 150 acres of hills and woodland. . . . We have word of additional achievements of **William B. Elmer.** He has designed two reflectors for Gemini and Apollo flights including Apollo II. Bill is moving to Andover where his son Ned is entering Phillips Academy as a day scholar. . . . **Charles H. Taylor** of Cranston, R.I., has been honored as Superintendent Emeritus of the Cranston School Department. They have dedicated the newly completed Western Hills Junior High School to him. . . . **Harvey L. Williams** of Philadelphia has retired after a very active 25 years in international business and now continues as a consultant to the Fidelity Bank in Philadelphia and to a few industrial companies. He spends summers at Buzzards Bay and winters at Key Largo. He is responsible for the design and construction of a new three-million-dollar academic center at Tabor Academy, Marion, Mass., as chairman of the centennial building committee of the trustees.

Mildred Allen, Emeritus Professor of Physics at Mt. Holyoke College is secretary of the Sigma Xi Chapter and class correspondent for the Vassar class of 1916. She is doing research with Dr. Erwin J. Saxl, having joined him in writing "1970 Solar Eclipse as 'Seen' by a Torsion Pendulum." A most interesting paper. . . . **Roger Hayward** of Pasadena provided the illustrations and white-on-black drawings of marine animals in the new book by M. Grant Gross *Oceanography—a View of the Earth* (Prentiss-Hall, 1972) . . . **Robert Tonon** of Stoneham was re-elected to the board of directors of Associated Industries of Massachusetts. Bob continues as president of the Peter Gray Corp., in Cambridge. He is a former president of the International Metal Trades Association, Boston Branch. . . . We received word that **Ward E. Shearer** of Mt. Vernon, N.Y., was recently married.

The sympathy of our class is extended to the families of **William A. Riley** and **Morris J. Gordon,** both of Milton, Mass., and **Charles L. Gilkeson,** of Harrisonburg, Va.

Our notes will be reassembled and continued in the next issue as we try to transcribe the hastily and sometimes illegibly written features of our famous 50th. In the meantime Good Health to all of you!—**Whitworth Ferguson,** Secretary, 333 Ellicott St., Buffalo, N.Y., 14203; **Oscar Horovitz,** Assistant Secretary, 31 Montrose St., Newton, Mass. 02158

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Through Edmund Farrand, '21, we have received a news clipping of further beneficences of **Cecil H. Green** and his good wife Ida. The *San Diego Union* reports that Dr. Cecil "wrapped a $1 million surprise into an announced gift of $1.2 million to the Scripps Clinic and Research Foundation located on Torrey Pines Mesa north of San Diego. This new gift makes possible a further expansion in facilities and equipment for diagnostic radiology at this institution." Dr. Cecil remarked at the presentation that he had been much impressed with the efficiency of this organization having been a patient a few years back when through their radiological work a growth was discovered in time for successful surgery. Again we salute you classmate Cecil for your continued good works!

From **Howard F. Russell,** our former class president, we learn of the death of Colonel **Walter E. Richards,** U.S.A.F. (Ret) in July of this year. Previously Colonel Richards had advised us of his almost total disability. Both Richards and Howard Russell were members of the "order of Daedalians." Richards was to have received a citation and plaque "memorializing 36 years of dedicated service to the Order and to its Foundation." There are many more details which we are sending to Arthur Davenport for the Class History. Howard, who operates ham station W7HHC from his home in Sun City is a charter Daedalian having flown in France in WWI in 1918.

Myles Morgan last May received the British Iron and Steel Institute's Bessemer Gold Medal Award for contributions to the art of rolling steel. Myles joined the Morgan Construction Co. in Worcester, Mass., after graduation and rose to become its chairman in 1963. He is described as "one of very few Americans to receive this honor from the British Society." . . . **Royal Sterling** reports retirement from his company that he founded in 1935, Cinder Products Corporation of Warwick, R.I. After a spate of trout fishing in Nova Scotia, Royal plans to live condominium style in Stuart, Fla. He plans to see us again at the 50th Reunion. . . . **Philip S. Wilder** has informed us of the death of his beloved wife, Elisabeth Clark Wilder at sea on March 20, 1972. It seems they were on a Caribbean cruise when this sad event occurred. "Betsy", Phil tells us, will be remembered by many of us as office secretary to Wally Ross of the TCA in the basement of Walker Memorial. We sympathize strongly with Phil on his sad loss.

We are also obliged to report the death of **William Webster** in May 17, 1972. Webster graduated from the Naval Academy with the class of 1920 and received his M.S. in naval construction with our class in 1923. After naval service he joined one of the companies which became a part of the New England Electric System in which organization he rose to become chairman and chief executive officer in 1963. He served the U.S. government in many capacities during and after World War II along scientific lines and in later years was active in promoting the use of atomic energy for power production. He was a life member of the M.I.T. Corporation and a trustee of the Woods Hole Oceanographic Institution.

Edmund H. Miller writes that he continues to be "grateful for explication of Truth as the Science and Art of good business . . ." Ed has 26 grandchildren, aged from 1-22 years. Good luck Ed, may your idealism continue unabated! . . . **David W. Skinner,** Chairman of our 50th Year Gift Committee, tells us about the progress he continues to make in recovering from the stroke he suffered in December of 1970. After two months in the Newton-Wellesley Hospital and a further two months in the New England Medical Rehabilitation Center he got back on his feet with the use of a cane. In January of this year he and his wife went for a stay in Florida after deciding to retire from his position as head of the Polaroid Corporation. Now that he has dispensed with the use of the cane Dave still continues to exercise and hopes to be fully recovered in time for our 50th Reunion. Good show, Dave—we are delighted to hear about these later developments!

Early in July **Tom Rounds** spent a pleasant hour with Reunion Chairman **Herb Hayden.** Plans are developing nicely and based on Tom's report that over 140 classmates had contributed class dues (now over 150) Herb decided to increase our reservation at Marriott to 100 rooms.

Later in July Tom saw **Albert J. Pyle** at

his summer cottage on Crystal Lake, near Harrison, Maine. Al and his wife Miriam were in Italy earlier this year when Al contracted a combination of 'flu and prostate trouble. After some very fine no-cost doctoring in a hospital in Rome he recovered enough to come back home and have the operation in Wilmington. Al looks great and says he has enjoyed doing some writing for Dave Davenport's Class History.

Getting back to the necrology again we have few details about the following, merely dates: **Paul A. Bray** on May 21, 1971; **Van Court M. Hare** in 1971; **Eduardo Icaza** on May 28, 1972; **John V. Janes** on January 6, 1972; **Philip Lemler** in August of 1971; **Edward W. Smith** on March 7, 1972; **Maurice A. Spaulding** on August 31, 1970; and **Gerald L. White** on January 20, 1972.

As to address changes we have so many (over 50) that we feel it is just too much to report here in these days of space austerity about which we have been cautioned. Both the Alumni Office and my files are available upon request should you have mail returns in specific instances.—**Thomas E. Rounds,** Secretary-Treasurer, 4 Deer Hill Drive, Danbury, Conn., 06810

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Events that happen once in a century are news. August 9, Brookline was visited by a tornado lasting about one minute. Specifically, it ripped through the Longwood Cricket Club, scene of National Tennis Championships. **Martin L. Tressel,** at one time a member, and an annual participant would have grieved at the shambles had he not passed away on June 14, 1972. Marty spent all his years with Alcoa in Pittsburgh, Pa., but he was devoted to his avocation, tennis, and for years was a member and officer of several clubs, being influential on national tennis policies. The tornado chaos touched Institute alumni by the death of a daughter of Russell N. Cox '49, when she sought shelter in a small building that was lifted into the air and crashed.

Paul Cardinal, 50th Reunion chairman, reports a round trip from Naples, Fla., to New Jersey in July for a family reunion (a practice run), visiting enroute. He hoped to confer with **Jack Hennessy** on 50th Gift matters, chiefly needling procedures (Hoffmann-LaRoche training) to increase individual contributing activity.

John Fitch and Mary regretted missing Alumni Day, but they sailed and flew to Venezuela, Rio, Sao Paulo, San Francisco, back to Florida and then drove to Westport, Mass., for the summer.

Class Secretaries are a cooperative group passing on information of alumni. Walter T. Green, '12, sent me a clipping concerning the death of **Sidney Malcolm Doyle** on June 27 in Palm Bay, Fla., where he had retired. Sid took his degree in general engineering and was a member of Chefren and Corporation XV.

We were glad to hear from **Archie Carothers** in Corona, Calif., where he has been receiving his *Review,* relayed by the Postal Service from Flat Rock, N.C. Seems that an address computer lost its memory. . . . **Cy Duevel** and Mary finally made their way to Weekapaug, R.I., from Longboat Key, Fla., via the Adirondacks and Maine. The flue bug and a blood infection kept Cy *hors de combat* during February and March. Cy favors the 50th away from campus and a good snappy cardinal and gray plaid jacket with Tech seal for a youthful appearance.

Pret Littlefield sent me a note advising of the passing on of **Jack Tench** July 11, 1972. Pret and **Marshall Waterman** represented our Class at memorial services in Darien, Conn. Jack was a much-travelled mining engineer, inventor and an officer in his own steel construction concern. He invented a widely-used type of sidewalk grating. Pret and Marshall had visited him several times and report that in spite of bone cancer, his spirit was wonderful to the end.

A quote from an unidentifiable page: "If you're flying through rain, fog, clouds or gloom of night, say thanks to **Jimmy Doolittle,** the retired Air Force general whose flying exploits are endless. Doolittle (a product of M.I.T.) helped to devise and was the first man to fly wholly on instruments. Before that (September 1929) most of the passenger flying had been done by day and in good weather, so that the pilot could follow railway tracks and roads."

Our baby will arrive in June 1974, after a gestation period longer than an elephant's. It will be named "Class of 1924-50th Reunion Gift" and immediately enroll in the Institute's new Environmental Laboratory. One of the obstetricians is **Hoyt C. Hottel,** Professor of Chemical Engineering, who recently reported on an environmental study on pollution from fuels for power production. Both nuclear and fossile fuels create thermal pollution, but nuclear reactors cannot possibly be built fast enough to meet future power demands. Professor Hottel and his co-author believe that the sulfur and particulate problems of fossil fuels, abundantly available, can be solved.

An excerpt from a syndicated column concerns **Luis A. Ferre,** Governor of Puerto Rico. He is running for re-election, again plugging for statehood. He fought for it in a 1967 plebiscite, but the motion lost six to four. He relaxes after dinner, when possible, at a baby grand piano, playing sonatas and fugues. Art is his first non-political enthusiasm. Until recently, he owned the largest collection in the world of Italian Baroque and pre-Raphaelite art. He gave the 500 paintings to a museum in Ponce, P.R. which he had Edward Durell Stone build.

Colonel **J. Lynch Piland** has retired in San Antonio, Texas. . . . **Charlie Herrstrom** is now receiving mail at P.O. Box 2603, Sarasota, Fla. Why would a patent lawyer forsake Cleveland, Ohio for the Circus Hall of Fame and Jungle Gardens? . . . **Roland N. Black** moved to 205 DeSota Drive, Richmond, Va. 23229. With the only Choir Master degree in the Class, the area must need a baritone or baton wielder. . . . **Dick Jackson** from Tampa, Fla., says he is hale and hearty and flies a light plane for fun. Made his 50th at Exeter, but had to miss the Naples Fiesta.

We regret to report the passing on of **Alfred L. Bailey** on February 15, 1972 in Rochester, N.Y. and **Oscar A. Keefe** on June 18, 1972 in Lincoln Park, N.J. To all the wives and families of our departed members we extend our earnest sympathies.—**Russell W. Ambach,** Secretary, 135 Aspinwall Ave. Brookline, Mass. 02146

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Summer is moving along at this time of writing and, for me at least, Tech affairs started with Alumni Days. This immediately raises a question: is this correct or should we adopt some form of spelling that represents the two sexes of graduates? We had there at various times the following members: Harold Balcher, Mr. and Mrs. F. LeRoy (Doc) Foster, E. Willard (Will) Gardiner, Garvin (Chink) Drew, Mr. and Mrs. James Howard, Mr. and Mrs. Edwin Kussmaul, Frank Mulcahy, Milton Salzman and Mr. and Mrs. Sam Spiker.

In late June your Secretary and wife went on a trip to the Alaska coast and the Canadian Northwest Territory, including the Yukon north of the Arctic Circle. Twenty-four-hour daylight certainly interrupted our time schedule. It is interesting country, now developing and will have a large part in Canada's future.

William F. Sonnekalb, Jr., is listed as a member of the firm of Davis, Hoxie, Faithful and Hapgood of New York City. . . . **Parker C. Reed** writes that as a retired materials engineer he is still doing some industrial consulting. . . . **George B. Blonsky** of New York comments as follows: "This year I am very busy keeping myself busy, that is having to do nothing really productive. I am retired to the life of observation, meditation, and trepidation. The last one because many things that happen today fail to please, enthuse or even touch me."

I am sorry to report the passing on April 28, 1971 of **Daniel D. F. Yellott** of Reistertown, Md.; on January 17, 1972 of **John W. DeKay** of Bloomfield, N.J.: on July 26, 1971, of **Morris Cohon** of Englewood, N.J.; and of **George W. MacDuff** of Jamaica W.I. on April 3, 1972. George was a consulting engineer for Stone and Webster, Inc. and in the 1930s was transferred to Jamaica. He was a native of Fall River, Mass., and private graveside services were held in that city. Besides his position with the Jamaica Public Service Co. he served as a director of other companies in Jamaica. He is survived by his widow, two brothers and several nieces and nephews.—**E. Willard** (Will) **Gardiner,** Secretary, 53 Foster St., Cambridge, Mass. 02138

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A mid-August Sunday morning that is clear and crisp and breezy is no time for a sailor to be writing class notes—but the notice says they are due. So with minimum comment on Pigeon Cove activities, here goes. . . . A note from **Phil Robinson** in Downey, Calif., tells us: "Still working (self-employed as consultant) although officially 'retired' from

Latchford Glass Co., where I was associated the past 17 years. My wife Virginia and I were at our third son Joel's graduation from M.I.T. in 1968."

Doug Jeppe writes from N'Oleans (Is my pronunciation correct?): "Moved to N.O. in 1955 and retired in 1965. Still living in and loving N.O. It's a great place to live—better even than Pigeon Cove! I own and operate a tax keeping and advisory business, but still have plenty of time for golf, fishing, gardening, and travel—you name it, we've been there. Welcome mat is always out for M.I.T.-ans visiting or passing through our lovely city."

Howard Lane tells what he is doing in New York State: "After retirement in 1969 following 39 years as an engineer in A.T. and T. Co. Long Lines and three years in U.S. Army Ordnance, I am now doing engineering work on a part-time basis in the Village of Brewster, N.Y. I am also busy gardening around my home and occasionally take short trips around the country."

Having just about boxed the compass with notes from classmates we note that **Jim Drain** has changed his permanent address to 414 Andrews Ave., Delray Beach, Fla. 33444—no further comment from Jim. . . . **George Breck** writes from Plymouth about his genealogical interests —an activity which seems to be of interest to many classmates. We recall that Ben Richardson was up to his ears in it even before he retired. George tells of another '26 man who is a real pro: "I bumped into classmate **Lebaron Carlton Colt,** by mail, a couple of years ago. He was then a professional genealogist in Boston and finding it a welcome change from the strains of business. My wife and I have been active in this same field, having just finished heading up in 1971 the writing, by committee, of the 1968 supplement to *The Eddy Family In America,* a 560-page book (small type) on many Eddy descendants, including myself. For 12 years, I've been president, etc., of this Family Association, a nationwide organization of 500 members. Have been unable to interest Emerson Wick Eddy though as he and his siblings have no Eddy children. Ten years ago, we acquired the 1803 Eddy Homestead (historic house) in Middleboro, Mass., in which organization Ruth and I have also been active. All of this could be a full-time activity if one wished."

Finally **Don Chase** writes from Cape Cod: "We have just completed our first year here in Yarmouth Port and couldn't be happier. We are making a trip out through Banff, Vancouver, Seattle, Grand Tetons and Salt Lake City for our 25th anniversary this summer."

Before signing off we must tell you that on the two days before these notes are due we are having the "Bullseye" National Championships here at Rockport. You will recall that the "Bullseye" is the small keel boat designed by Nathaniel Herreschoff who graduated in 1870, M.I.T.'s second graduating class. The design is exactly as he did it fifty years ago but they are now made of fiberglass. At our regatta we will have about 25 of them hitting the line. So as we said in our opening sentence, it's a nice clear breezy day—let's get out for some practice! Cheerio plus a Happy Thanksgiving.— **George Warren Smith,** Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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Bob Bonnar and his 45th Reunion Committee did as close to a perfect job as is humanly possible—an ideal location, good accommodations, good food, good service, good fellowship, and even good weather. If you missed it, you missed a joyous weekend; better plan to be there for the 50th.

There were 45 of the class who made it to Bald Peak Colony Club at Lake Winnepesaukee for the June 2 weekend—about one in ten of the present active class roll—plus 33 wives. About half of us went down to Cambridge for Alumni Day, and there we were joined by another ten members of the class, several with their wives. This was the second quinquennial reunion to which wives were invited—after 35 years of "men only"—and the girls really enjoyed it.

Bill Kaplan came all the way from San Diego—he travelled the farthest—while **Ned Anderson** and **Brad Gerrish,** who have summer homes nearby, had only to come across the lake. **Ed Dunn** had signed up to come, and we were looking forward to meeting his new bride, but he changed plans at the last minute. Jill and **Bill Taggart** reported the largest number of grandchildren—ten; no one in the class has yet reported a great-grandchild. The earliest retirement reported—excluding **Anson Rosenthal,** who claims to have retired in 1927—was by **Lloyd MacAdam,** who left the Army in 1960; he beat **Joe Harris** by two years.

It was good to see **Jim Lyles** so much improved. Throughout his long illness, he has kept his good nature and his sense of humor. Your secretary was fortunate enough to sit next to him at the dinner at Bald Peak, and his comments on the proceedings and the people were uniformly complimentary, or witty, or both. **Joe Burley** headed the sports program, with **Ezra Stevens** in charge of golf and **Dike Arnold** of croquet—the two popular sports. The committee had assembled an attractive group of prizes. For the record, the winners were: Golf, Low Gross and Low Net, Dave Truax; second low net, Frank Staples; third, Ray Hibbert; Kickers, Steam Harrison, Frank Meyer, Don Wylie; and a special prize to Bob Bonnar for coming in last. Ladies' Putting, Winifred Meyer, Barbara Wallace, Cecil Stevens. Tennis, Larry Day. Mixed Croquet, Charlie and Eleanor Smith, Dick and Mary Hawkins. Ladies' Croquet, Eleanor Smith and Molly Lyles, Ann Bartlett and Ruth Whittier. Horseshoes, Fred Willcutt and Russ Westerhoff. Shuffleboard, Dave Truax and Fred Willcut. The door prizes went to Ned Anderson and Johnny Drisko.

At the Class Dinner on Saturday night, June 3, the following were elected to hold office until 1977: Honorary President, Jim Lyles; President, Ray Hibbert; First Vice President, Bob Bonnar; Second Vice President, Bill Taggart; Treasurer and Reunion Chairman, Bob Bonnar; Secretary and Historian, Joe Melhado; Reunion Gifts Chairman; Bud Fisher; Class Agent, Dick Hawkins; Class Estates, Bill Taggart.

1927 Class Officers at their 45th Reunion: R. F. Hibbert, President; J. R. Bonnar, First Vice President and Treasurer; J. H. Melhado, Secretary and Historian and D. C. Arnold, retiring President.

Those present at Bald Peak were Ned and Winifred Anderson, Dike and Jean Arnold, Charlie and Ann Bartlett, Bob and Fran Bonnar, Joe and Ruth Burley, Gordon Calderwood, Carl and Harriet Davies, Larry and Eleanor Day, Johnny Drisko, Jack Eldert, Horace Emerson, Bill Felsch, Howard and Celia Ferguson, Bud and Hope Fisher, Brad and Madeline Gerrish, Larry and Lillian Grew, Joe and Ann Harris, "Steam" and Kay Harrison, Dick and Mary Hawkins, Ray and Zella Hibbert, George and Mary Houston, Bill Kaplan, Tom and Marian Knowles, Dave and Dorothy Knox, Jim and Mollie Lyles, Lloyd MacAdam, Joe and Marion Melhado, Frank and Winifred Meyer, Nat Mintz, Bill and Elizabeth Payne, Lauritz Rasmussen, Phil and Eugenia Rhoads, "Rosie" and Sheri Rosenthal, Charlie and Eleanor Smith, Frank and Doris Staples, Ezra and Cecil Stevens, Bill and Jill Taggart, George Taminosian, Dave Truax, Bob and Barbara Wallace, Russ and Catherine Westerhoff, "Pub" and Ruth Whittier, Fred Willcutt, Les and Ethel Woolfenden, Don and Helen Wylie.

At Cambridge, Lauritz Rasmussen was joined by his wife, Gertrude, and the Burleys by their daughter, Jane—1927's class baby. (A most grown-up, intelligent, and attractive Class Baby, now at Vassar.) Also joining us at Cambridge were Jack Boyle (whose wife's illness had kept him from Bald Peak), Ed Chase, Robert Hawkes, Ed McCabe, Sam Pearlman, Ralph Peterson, "Judas" Priest, Bill and Helen Richardson, and Morris Leonard and Roger Nowland with their wives. (If I missed anyone, please let me know.)

Charlie Smith reported a recent visit at Cincinnati from our classmate, **Chungsoo Oh,** who came to M.I.T. from Korea by way of Shanghai, Seattle, Denver, and one year at B.U. Chung-soo's father sold the family cow to finance his son's passage to the United States, and Chungsoo worked his way through high school in Denver and through B.U. and M.I.T., winding up with a degree and a debt of $2,000. After working his way back to Japan and Korea, he became manager of

N. Cohn, '27

a Corn Products Refining Co. plant in North Korea and subsequently started his own corn grinding plant. After selling out, he went into business in South Korea and became, first, deputy director and then head of the Department of Commerce and Industry in South Korea. He is now representing NCR and Monsanto in Korea and Singapore.

Russ Westerhoff stepped down as president of Ford, Bacon and Davis, Inc., in April but has continued as chairman of the board of directors. He is tentatively planning retirement from the chairmanship in 1973. . . . **Larry Coffin** keeps active; he is on the staff of Admiral E. J. Rodgers as business consultant of the Maine Maritime Academy, Cortine, Maine, and was planning a European cruise in the Schoolship S.S. *State of Maine* as representative of the Maine Department of Agriculture. His home is in Mt. Desert Island. . . . **Dal Sparre,** who retired from DuPont in May, 1971, has been self-employed since as a legislative consultant, mainly on product regulation. This past spring, he was on assignment with the Chemical Specialties Manufacturers' Association in New York City—with side trips to Albany, Pittsburgh, and Huntington, L. I.

Nat Cohn has retired as executive vice president of Leeds and Northrup after 45 years of distinguished service. During his years with the company, he devised many of the fundamental concepts and techniques now used for automatic control of interconnected power systems. He holds numerous patents in this field, and his technical papers on the subject have become basic international references. His book, *Control of Generation and Power Flow on Interconnected Systems,* is used throughout the power industry and as a college text. He is a life fellow of I.E.E.E., a member of the National Academy of Engineering, a Fellow of I.S.A., a member of the National Society of Professional Engineers, and a member of honor societies Sigma Xi, Tau Beta Pi, and Eta Kappa Nu. His awards include the Lamme Medal of the I.E.E.E., the John Price Wetherill Medal of the Franklin Institute, and the Albert J. Sperry Medal of the Instrument Society of America. He is continuing as a director of Leeds and Northrup, Chairman of the Franklin Institute, and in a number of professional societies and civic posts.

Percy L. Richardson has moved into a condominium apartment in Venice, Fla., but is keeping his New Hampshire cottage also. . . . **Charles W. Dinan** is enjoying his leisure years after retiring from Koppers Co. . . . **John W. Harris** has been 39 years with Metropolitan Moving and Storage Corp. and has no plans to retire. . . . **Maurice Barrangon** retired in March from the Southwest Research Institute in San Antonio; he had previously been with A.S.M.E. in New York. . . . **Bradford Stetson** writes that he is still enjoying the Florida sunshine in his fifth year of retirement. . . . **William B. Duffy** retired last November after 41 years as superintendent of public works in North Andover, Mass.

Deaths: From Charles Dinan we learn that **John F. Healey** passed away last September. . . . **John S. Buhler** died in May; at the time of his retirement in 1969 he was manager of the Scientific Projects Division of North American Philips Corp., and traveled extensively in this country and abroad supervising the installation of cyclotrons, linear accelerators, and other specialized equipment. He was a resident of Yonkers, N.Y. . . . **Laurence Burns,** chief patent attorney and manager of patents of Sylvania Electric Products, Inc., died in July at his home in Swampscott. He was the author of a number of published theoretical scientific articles and a member of several professional and civic groups, including the Poet's Forum of Lynn, of which he was past president. Over the years, he had composed more than 250 poems. . . . **Ernest H. Dodge** died on April 16. He had retired to an old country house in Hopewell Junction, N.Y. in 1968, after 40 years with the Long Lines Division of the Bell System. . . . **Marcel Du Bois,** who had been living recently in Geneva, Switzerland, passed away on August 10. . . . We have just heard that **Ely James Sax** died on December 8, 1971. At last reports, he was with the patent office in Washington; his home was in Chevy Chase. . . . We have also just learned that **Leland D. Webb** died in Los Angeles in September, 1971.

It is a shock to report so many deaths among our classmates in a single issue. The sympathy of the class goes to all their families.

Your secretary has a note from Orissa and **Dick Cheney** reporting that they have moved to 400 East Pedregosa Street, Villa B, Santa Barbara, Calif. 93103, after so many years on Sutton Place. Dick retired in June as president of the Glass Container Manufacturers Institute.—**Joseph H. Melhado,** Secretary, 24 Rodney Road, Scarsdale, N.Y. 10583

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Homecoming Weekend at M.I.T. provides a wonderful opportunity for classmates to gather. This year our class had a very good turnout. Those attending were: Sylvia and Max Bearon, Rose and Maury Beren, Ruth and Bob Carder, Ruth and Chris Case, Barbara and Earl Crawford, Frannie and Jim Donovan, Olive and Newt Foster, Dot and Carney Goldberg, Florence Jope, Janet and Fred Lewis, Judith Miller, Mary Nichols, Gladys and Dave Olken, Anne and George Palo, Madeline and Hal Porter, Walter Smith, Dorothy and Herb Swartz, Anne and Will Tibbetts, Lou and Sam Weibel, Ruth and Abe Woolf. The entire program was excellent and there was again the special pleasure of meeting and chatting with old friends. Judith (Mrs. **Benjamin F.**) **Miller** was particularly appreciative of the services held on Alumni Day for those recently deceased. Ben, who wrote extensively on medical subjects, had finished work on his last book just prior to his death. This work, *The Family Book of Preventive Medicine* now has been published. It has had excellent critic support and prominent promotion by the Book-of-the-Month Club.

Coming from Japan, we have a most welcome letter from **Shikao Ikehara.** Shikao is still teaching mathematics and is frequently called upon to talk on cybernetics. He is glad now that his was a broad background of training in chemistry, physics, and mathematics as well as in electrical engineering. Shikao deplores the current steep rise of prices in his country. Pollution is also seen now as a serious problem in Japan but hopefully it has been recognized in time for correction. Shikao remembers with great pleasure the 40th Reunion at Cambridge and asks to have his best wishes conveyed to all classmates. . . . Again from the Far East: Nat and **Des Shipley** visiting Hong Kong, sent a greeting card to **Jim Donovan.** Des asked Jim why he doesn't retire and start relaxing. Never knowing where Des might be next, Jim has requested that his reply be made via these notes: Des, Jim says he would rather work than retire but could do with a few less miserable problems! . . . Another pair of travelers, Anne and **Will Tibbetts,** sent their greetings from Greece which they found to be a most fascinating country. Later they were planning to travel in Italy for a total of six weeks or more in Europe. . . . Priscilla and **Roger Haven** did their traveling this year in the U.S.A. and Canada on a journey to "See America first." The trip was unhurried and covered the western states, west coast, Vancouver, Banff, Jasper, Calgary, Yellowstone and back through the northwest states. They were awed by the vastness and beauty of what they saw.

Eight members of the M.I.T. faculty retired this year. One of them was **Robert S. Woodbury,** Professor of History of Technology. Quoting from *Tech Talk* of May 17, 1972, Bob ". . . received the S.B. degree in mathematics from M.I.T. in 1928 and the A.M. degree from Harvard University in 1936. He joined the Institute staff as an instructor of English and history in 1929, was promoted to assistant professor of the history of science in 1936 and in 1946 became assistant professor of English and history. He was appointed associate professor of humanities in 1959 and professor of the history of technology in 1963."

A short message from **Ed Petzold** says: "After working for about 35 years with Standard Oil Company (N.J.) and its various affiliates, primarily with their aviation activities all over the world, I took an early retirement in 1964. Since then Carolyn and I have done some traveling. Now we usually spend our winters in Coconut Grove, Florida and our summers in Maine. In the spring and fall we are gen-

erally in New Jersey."

With deep regret we must report that **John Stack** died on June 18, 1972. His death resulted from injuries when he fell from the horse he was riding at his farm near Yorktown, Va. John was widely known and recognized for his work on the development of high speed wind tunnels and on advanced types of high speed aircraft. His achievements won him aviation's most prestigious honors including the Collier and Wright Trophies. Prior to his retirement last year he was vice president of Fairchild Industries.—**Walter J. Smith,** Secretary, 209 Waverly Street, Arlington, Mass. 02174

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The following Twenty-Niners attended the Alumni Day activities last June 4 and 5: Doris and William Baumrucker, Grace Farrell, Joan and Wally Gale and their daughter, Paul Keyser, Mary and Frank Mead, Thomas W. McCue, Joseph L. Speyer and his wife, Olive and John Rich, Elizabeth M. Stefani, David Wilson and his wife, D.A. and John Wilson, and your Secretary and his wife Helen.

Grace Farrell is a graduate of Wellesley College, Class of 1927, who joined our class in graduate work in public health. She is the head of Brookline Public Health Department. . . . On June 10, a signal honors was accorded to **David H. Wilson,** past Master of the Henry Price Lodge, A.F. and A.M., in the Statler Hilton Hotel, in recognition of distinguished service to the Jewish people and Freemasonry. . . . **Otto E. Wolff** of Weston, Mass., has been named vice president and senior engineering fellow at the Polaroid Corp.

I regret to announce the death of **William Tarbox** on June 13, 1972. He had a long association with the Bethlehem Shipbuilding Company as chief engineer in the Staten Island (N.Y.) Yard and later at the Quincy Shipyard. He was a member of the Long Service Club of the Fore River Shipyard in Quincy, the Institute of Marine Engineers, and the First Congregational Church of Braintree. He is survived by his wife, Bertha, a daughter, a son and his mother Mrs. Diantha E. Tarbox of Braintree.

James C. Reddig of Webster, N.Y., retired from the Kodak Co. in February, 1972. His wife Gerry says that he is as busy as ever and there are not enough hours in a day to do all that he wants to do. . . . A brief note from **Charles Frank, Jr.,** of Waltham, Mass., reads, "I have been commuting to Lynchburg, Va., the fastest growing city on the eastern seaboard, where my wife owns a home. I make the trip once a month by car or plane, depending on the weather. While there, we attend a businessmen's fellowship meeting." . . . **Richard T. Hoffman,** of Memphis, Tenn., writes, "Entered slalom in a water ski tournament not long ago. A fellow contestant said that I'd have to fight for last place. My best efforts got me eighth place—among eight contestants."

Bion Francis of Milford, Conn., writes, "Most important development with me is that I have now retired from the Colt Industries. I assume that our classmates are doing this in increasing numbers. I am doing some writing and recently sold a series of articles." . . . **Whitney G. Sexton** of Malakoff, Texas, writes that retirement is wonderful and rewarding, having no deadlines to meet and free from the rat-race of the Big City. He says, "Doing such menial jobs as gardening, composting, carpentry and painting (not on canvass) with great interest, probably because I am not compelled to do them. Old age can be very happy time, if you have your health."

Clayton F. Jarvis of Amesbury, Mass. is a construction engineer with the General Services Administration, operating from the Federal Building in Boston. His daughter Jane is a freshman at Wellesley. . . . Captain **Howard B. Hutchinson,** (U.S. Navy-Retired) of Mount View, Calif., sends thanks for the birthday card. Having received his master's at M.I.T. specializing in meteorology, he greatly appreciated his experiences in a nonmilitary school and his association with life at M.I.T. broadened his views on life and made him more tolerant of other people's opinions. "During my lifetime," he continues, "meteorology has become completely computerized, and observations once taken on the back seat of an open cockpit of an airplane are now performed by a TV camera mounted on a satellite."

George F. Badger of Northfield, Ohio, has just retired as Professor of Medicine, Case Western Reserve University in Cleveland, Ohio. . . . **Hunter Rouse** of Iowa City, Iowa, has sent a card from Stockholm, Sweden, "Greetings from the Environmental Conference! Everyone who is against pollution (or against the U.S.A.) is here, especially the Third World. It is a liberal education. The city is very interesting as you can see from the card. I am lecturing at the Royal Institute of Technology. I'll send you a card in the fall from South America." . . . **James C. Coe** of Phoenix, Ariz., has retired and for a hobby, writes articles for the *Lapidary Journal* and *Gem Magazine.*

Newell W. Mitchell of Southbury, Conn., writes, "Much water has gone down to the ocean since I bought my slide rule from you in 1925. I still have it and still use it now and then. I am active in Appalachian Mountain Club and Litchfield Hills Audubon activities, and related conservation and education oriented endeavors. . . . **Richard E. Bolton** of Montreal, Canada, is semi-retired and since 1970 has been winding down his ownership and responsibilities in a lively architectural practice which was founded over 50 years ago. His professional work has taken him from Germany to Newfoundland, to the mouth of the Mackenzie River and the west coast of British Columbia. He is currently serving as chancellor of the College of Fellows, Royal Architectural Institute of Canada. . . . **Mark W. Libbey** of South Berwick, Maine, has retired. He sends his greetings, expressing appreciation for the birthday card.

I have an encouraging note from **Brig Allen,** first president of our class, from Orlando, Fla. "Your birthday card was greatly appreciated. Your efforts should get you some news, having made it so easy, though it accentuates the unpleasant thought that we are getting old. Time seems to go so fast here that when I write a check I have to stop and ask the day, the month and the year. I had planned to send you a note almost three years ago when we first moved down here. I had a rough year in 1971 with four trips to the hospital with a congestive heart failure. Had to have my lung drained a few times and a prostate 'carbon and valve' job done. I have been doing fairly well since the first of the year. My father celebrated his 70th reunion at M.I.T. last June. There are about six or seven members left out of an original class of 260. I am glad to say that at age 92, he is still percolating good. **Frank Mead** and his wife Mary paid us a visit last winter. I hope to be playing golf again by the time they come over next winter. I understand **Charlie Denny,** who lives in Naples, Fla., had a rough year, but he has improved somewhat. We would be happy to see any '29er who is passing through. We are just three blocks from route 1 and 4 and two miles from the Florida turnpike. Best regards to all."

An interesting letter comes from **Morris Smith,** Haifa, Israel, which reads, "I was working as an electronic compatibility engineer (EMC) with North American Rockwell in Downey, Calif., until January 1971 when the aerospace layoffs hit me. In the following six months, I tried several approaches to work, formed a consulting service with a group of alumni from the M.I.T. club, helped develop some (unsuccessful) proposals to the Department of Transportation, and worked with Experience Unlimited of Santa Monica, a self-help group of unemployed aerospace professionals. It is a most useful organization and deserves much credit for job search methods. Then four months later, we decided to move to Israel, which has had a strong spiritual attraction for me for many years. We landed in Israel on November 29 on my birthday. Even if I were not a committed religious Jew who feels that my self-fulfillment can only be achieved through my faith, and that Israel provides an outstanding opportunity to achieve my goal, I would still find Israel an exciting land to be in. Its problems and challenges remind me of the birth of our own country and I am happy to be a part of it. I hope to be working in the EMC field again soon. Shalom and lahitrahoit."

Frank Lammers of Wilmette, Ill., sent thanks for his birthday card. Instead of thinking of retirement, he is expanding warehouse and distribution facilities for pneumatic and hydraulic power equipment. He has a condominium in Florida where he enjoys surf fishing and golfing. His latest hobby is stainless metal art work. Sends his regards to all alumni from 1927 to 31 range. . . . **Jonathan F. McCray** of Heber Spring, Ark., writes, "Retired in 1967 after 38 years with the Chesapeake and Potomac Telephone Co. of Maryland. Upon retirement, we returned to Arkansas where I had attended high school. In 1963 President Kennedy dedicated a flood control dam on the Little Red River as a part of the Mississippi flood control. The result-

ing impoundment of the Green's Ferry reservoir has changed the area quite a bit. Tourists and retirees have come in numbers due to the lake and the mild climate. We have built a house on a ten-acre tract of land we have owned through the years and we enjoy the "easy living" thoroughly. My time is occupied principally by volunteer work, little golf, little fishing, boating and travel."

The *Chemical Engineering Education Journal*'s winter '71 issue honored **John Happel** of Hastings-on-Hudson, N.Y., in a feature article, "An Engineer Becomes a Teacher", giving highlights of his career and present activities. Here are some excerpts: "Be sure it isn't a case of the Greener Grass Law, advised Ken Watsen when John Happel decided to leave his industrial career for teaching. His first position after leaving M.I.T. began at the laboratories of the Standard Oil Co. of N.Y. in Brooklyn. There, after ten years, he had become a supervisor in charge of a section of 50 scientific personnel engaged in a variety of activities, from designing of refining equipment to running a fleet of test cars. During WWII, he was one of a technical committee charged with the design and initial operation of the world's largest synthetic rubber plant. Following the war, he worked with several major chemical companies on petrochemical projects and obtained his doctorate at Polytechnic Institute of Brooklyn. After 17 years in the oil industry, he accepted a position at N.Y.U. in 1948.

"He regards his second career, as professor, as being particularly rewarding, especially as he was fortunate in meeting Dorothy Merriam. She became his wife soon after he started teaching and along with his academic activities he launched on the project of being a father of three children, Jill, George and Ruth, now 17, 15, and 13 years old. Soon after, he became chairman of the Chemical Engineering Department, a position he holds at present. His teaching duties involved the initiation of a plant design course . . . based on his textbook *Chemical Process Economics*."—**Karnig S. Dinjian,** Secretary, 6 Plaice Cove, Hampton, N.H. 03842

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This year, as in past years, a respectable number of items have accumulated during the *Review*'s "summer vacation." Your entries on the Alumni Fund envelope flaps, although sometimes rather sketchy, are very helpful. . . . To start with the oldest item at hand, the M.I.T. Club of Mexico, which stages a most interesting and entertaining fiesta every year, has kindly provided us with the names of our classmates who attended the March 1972 edition. It seems that the class of 1930 was represented by Evelyn and **Charley Abbott,** Betty and **Warren Martell,** Doris and **Emilio** (Maco) **McKinney** and **Alfredo Gutierrez**. . . . From the *Phillips Exeter Alumni Bulletin* we learn that **Phil Holt** has retired from Esso Research and Engineering Co. after 34 years of service in research, process licensing and various administrative positions. His retirement plans include travel and the pursuit of numerous hobbies. . . . **Myron Falk** notes that he has retired but doesn't say from what. The Falks have three children: Patricia, who graduated from Bennington in 1960; Michael, who graduated from Columbia in 1966; and Nancy. . . . **Lawrence Gonzalez** has retired from his Navy Department job and appears to be doing considerable traveling. He lists the following travel recommendations: (a) one of the last paradises in the world—Penang, Malaysia, (b) beautiful green countries—Morocco, Austria, (c) interesting train ride—Bangkok to Singapore, (d) stimulating cities—Bangkok, Tokyo, Manila. The Gonzalez have a daughter Peggy who is an international economist, formerly with the Special Trade Representative of the Executive Office of the President and now with Overseas Private Investment Corp.

Among the 119 retiring M.I.T. employees and faculty members honored at a Walker Memorial banquet last June was **Alan Bemis** who has completed 33 years as a Senior Research Associate in the Meteorology Department. . . . Our former class president **Dick Wilson** has also retired as of July 1, 1972. At the time of his retirement Dick was manager of the film manufacturing organization at the Kodak Park Division of Eastman Kodak Company. He started with Kodak in 1931 as a chemical engineer in the emulsion coating department, became departmental supervisor in 1939, superintendent of the film emulsion coating division in 1951 and assistant manager of the film manufacturing organization in 1959. He is a former president of the M.I.T. Club of Rochester, trustee of the First Unitarian Church of Rochester, former director of the Rochester Music Association, Board member and former president of the Harley School and a member of the City Club, Genesee Figure Skating Club and Monroe Golf Club. . . . **Ruth Terzaghi** was a McGovern-pledged delegate from Massachusetts to the Democratic National Convention in Miami. . . . **Jim Rice** reports that he is still active in business as a textile conservationist and restorer.

Although he doesn't specifically say so, **Alvah Perkins'** report, quoted in full, strongly suggests that he has retired. "I follow the sun both summer and winter, plant a garden in the spring and rake leaves in the fall. Still a jump or two ahead of basket weaving, but if it comes to that it's at least useful and not without interest." . . . **Bill Lodge** retired as vice president of the CBS Television Network as of the end of 1971 after 40 years with CBS. He spends half the year at a new home in St. Croix, V. I., and the other half at his home in Hastings-on-Hudson. . . . **Edward Baldwin** retired from banking (the Register says First National Bank & Trust Co. of Ithaca, N.Y.) as of the end of 1971. At the time of writing he was in the process of returning to New England to live. He proposes to "continue helping my fellow man (on a strictly 'for hire' basis!) as soon as we are relocated, but I have yet to pick my precise field. It may be trust department consulting." . . . **Walter Soroka,** Dean of Continuing Studies at the University of California in Berkeley is chief consultant on acoustics of the new San Francisco Civic auditorium. Last year he designed acoustical plans for the San Francisco Transit System and the U.S.S. aircraft carrier *Coral Sea*. . . . Those of a statistical turn of mind may be interested in noting that more than half the classmates mentioned above are retirees.

Changes of address: Emanuel I. Birnbaum, 54 Glasgow St., Guelph, Ontario, Canada; Hugh MacDougall, UNDP 58-60 DJL Diponegoro, P.O. Box 2338, Djakarta, Indonesia; Ralph H. Swingle, 5200 N. Ocean Boulevard #1502, Ft. Lauderdale, Fla. 33308; Professor Raymond C. Biner, 2711 Manning Ave., Los Angeles, Calif. 90064; Theodore A. Riehl, 8125 N. Casas Way, Tucson, Ariz. 85704; Walter S. Smith, 3915 So. Lewis Place, Tulsa, Okla. 74105; Paul H. Kimberlin, 904 Christmas Tree Lane, Arizona Sun Sites Heights, Pearce, Ariz. 85625—**Gordon K. Lister,** Secretary, 530 Fifth Avenue, New York, N.Y. 10036

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My apology for slipping up on our Class Notes for the past six months. My wife, Louise, died suddenly, just before Thanksgiving . . . and it has taken me some time to get back into the swing of things.

A note from **Claude Machen** tells of his retirement on June 30. He will continue as Chairman of Boston Gas Company and will be active on several boards on which he serves. He expects to continue living in Wellesley and hopes to get to warmer climates for at least part of the cold weather and is looking forward to golf, travel, photography, carpentry and business involvements of not quite so demanding a character.

Everyone is enthusiastic about the coming 42-½ year Reunion in Mexico City, with **Polly Germeshausen** as Chairman. Tentative dates for the Reunion are March 15-17, 1973. More on this later.

Louis Evans writes that he is now conducting training programs for technical personnel in Mobile Oil's worldwide manufacturing operations. Most of the instruction, he says, is given at their Research Center in Paulsboro, N.J., but some courses are offered overseas which gives him an opportunity to travel. . . . **Howard Huntress** wrote that his youngest son is now a doctor of dental surgery and has a residency at Sloane-Kettering Institute in Manhattan. Howard has sold his boat and his present job involves sitting in a secluded office solving heat-flow problems on a computer. . . . **Ed Goodman** writes that after many years of trying corporate industrial engineering, he has switched to managing foreign facilities. . . . A newspaper clipping tells of **Ed Ducayet**'s election as chairman of Texton's Bell Helicopter Division. . . . **Bill Dodge** tells me that he is retiring this year as director of corporate research for International Paper Company and will probably be living in New London, N.H.

A note from **John Dodge** tells of his retirement last winter. Prior to that he was consultant to the Department of Public Instruction of Puerto Rico and also taught a course in physical science for teachers. at the University of Puerto Rico. . . . Word has been received that **J. K. Jamie-**

son has been elected to a second five-year term on the M.I.T. Corporation. **Fred Nordsiek** wrties that he is now associate scientific director of The Council for Tobacco Research-U.S.A. and is located at 110 East 59th Street, New York City 10002 (tel: (212) 421-8885). . . . **Eugene Lourie** has advised us that he retired from his position as electrical engineer for the Chevrolet Division of G.M. last December, after 30 years of service.

A. D. Vincent says that he is a member of 5-Florida State Board of Pollution Control and has been actively engaged in the state effort to clean up inland waters for the past three years. . . . **Herbert Raymond** reports that his new business is as financial manager, American University Press Services, Inc., 1 Park Avenue, New York City 10016 (tel: (212) 889-3510). . . . My deepest sympathy to **Emilio Collado** whose wife died recently. An article in the July 21 *Honolulu Star-Bulletin* mentioned that Emilio, who headed the Committee for Economic Development Panel which recently recommended that the government devise criteria procedures for selective determination of wage-price controls, left the impression at a news conference that the Committee would find higher taxes an undesirable route to reduce fiscal stimulation.

It is with considerable sadness that I report the deaths of the following classmates since the last Class Notes were received: **Tufic-Antonio Chemor** on January 15, 1972; **Benjamin F. Clark, Jr.** on July 15, 1968; **John Fairfield** on November 13, 1971; **Irving W. Finberg** on October 30, 1971; **Harlan Glidden** on October, 1971; **Edward M. Heffernan** on January 30, 1972; Our Class Treasurer, **Bill Jacobs** on June 19, 1972; **William C. Mentzer** on December 23, 1971; **James W. Perry** on December 24, 1971; and **Samuel Ryan** on June 13, 1971. Our deepest sympathy to all of their families.

One final word—let's not forget our 42½ Reunion in Mexico City.—**Edwin S. Worden,** Secretary, 35 Minute Man Hill Westport, Conn. 06880

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The Fortieth Reunion, June 2-4, 1972, was very successful with a turnout of 64 classmates and 53 wives for cocktails and dinner at the Faculty Club June 3, graced by distinguished guests Dr. and Mrs. Jerome Wiesner, Dr. and Mrs. James Killian, Howard Johnson and Mrs. Johnson, Dr. and Mrs. Paul Gray, our personal Professor Ray Douglas and Mrs. Karl T. Compton who added a delightful touch with her informal remarks on the early days of 1932 at the "big house" on Memorial Drive. The Alumni Association was represented by Mr. and Mrs. Peter Grant, Donald Severance, Mrs. Conchita (Lobdell) Pearson and Mr. John Mattill. Accolades and thanks to Chairman **Ed Nealand, Harry Moore, Don Whiston** and all their committee members and wives for a job well done. Nothing but complimentary remarks were the order of the day—and nary a complaint—on the arrangements and food. **Bob Semple,** 40th Year Gift Chairman, and **Tom Sears,** Class Agent, deserve the individual and collective thanks of the entire class for their work and results on the Gift Drive. These classmates and their group assistants worked tirelessly to produce a very effective and much appreciated result—$363,000 to M.I.T. from 318 members of the Class of 1932.

The 38th Year Reunion group of classmates and wives who went to Spain in June 1970 held an informal reunion at the Student Center June 2, with a reception and dinner for Zuzanne and **Juan Serrallach,** our most gracious Spanish host and hostess—19 out of the original 24 couples attended.

An interesting postscript to reunion statistics—more than 100 of the 1932 Class answered first reunion mailing, with 80 responses containing initial expense contributions. Included were, **Bernardo Abrera,** Quezon City, Philippines, and **Charlie Wyatt,** Holland House, Hong Kong.

Your new class officers for the period 1972-1977, proposed and submitted by Chairman **Don Gilman** of the nominating committee at the class banquet are: **Donald Whiston,** Class President; **George K. Kerisher,** Treasurer; **John W. Flatley,** Secretary, and **Donald W. Brookfield,** Assistant Secretary; together with the following world-wide Vice Presidents representing their respective areas: Robert E. Minot, Boston; Arthur M. Marshall, New England; Clarence M. Chase, New York City; Col. James E. Harper, Mid-Atlantic; Theodore J. Jones, Southeast; Thomas W. Regan, Illinois; Wendell E. Bearce, Ohio; Otway W. Rash 3rd, Missouri; William A. Kirkpatrick, Michigan; John Lawrence, Texas; Charles C. Wyatt, Northwest and Far East; Prof. Rolf Eliassen, West Coast; Nicholas G. Velez, Latin America; Juan P. Serrallach, Western Europe; and Manley St. Denis, Hawaii.

We owe sincere thanks to our classmates who arranged and handled the reunion activities and to the M.I.T. administration and staff, whose red carpet treatment afforded such warm and friendly hospitality. To all who contributed to the program and those who participated in it go the best wishes and deep gratitude of your officers and committeemen.

Among the regrets of those who had planned, but were unable to attend: **Ed McLaughlin,** recently retired, and just returned from a trip to Tahiti, attending a family wedding on June 3; **Don Corson** got tied up with an "absolute necessity of spraying trees now, unable to be there. My regrets to everyone and hope to see everyone at the 45th"; **Tom Regan's** company "in the last stages of a merger" so he was "hemmed in eight ways for Sunday" and couldn't make the reunion. Tom took an extended trip in April through Spain and Portugal; **Jack Kellman** "had planned" but instead of Cambridge, commitments in Brazil prevented attendance. His traveling covers over 100,000 miles per year through Asia, Europe, and the Americas, with no present plans for retirement.

From the mailbag **F. R. Smith** recently retired as president and manager, Fraen Corp., Wakefield, Mass. . . . **John A. Bellizia,** after 35 years with Massachusetts Department of Public Health, has joined the Bureau of Environmental Sanitation as Director of Nashua River Program. . . . **George L. Green** received a nice retirement gift from the *Providence Journal,* a cruise trip to South America. . . . **Philip E. Keene** retired as director of architectural work at Washington State University after 28 years, 25 of those as university architect and director of the Department of Facilities Planning. According to the news reports, he has been responsible as much as any one man could be for nearly 75 percent of the present campus buildings. . . . Honored at Retirement Banquet, in Walker Memorial, our recent Class Secretary **Elwood W. Schafer. . . . Howard R. Pyle** recently retired from Hercules, Inc. as heating, ventilating, air conditioning and refrigeration engineer. . . . **Jacob Millman** has had his sixth textbook published by McGraw-Hill, *Integrated Electronics,* and his son Jeffry is presently a teaching assistant in electrical engineering at M.I.T. . . . **Erskine G. Roberts,** Vice President of W. V. Rouse Associates, Ltd., has recently had published his development work on Atomic Accelerator and Fast Breeder Reactor Cooling Technology.

Word has been received of the death of **George H. Carter** who received his master's degree in architecture.—**John W. Flatley,** 6652-32nd Street, N.W., Washington, D.C. 20015; **Donald W. Brookfield,** 168 Massapoag Ave., Sharon, Mass. 02067

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Well, fellas, the press and Fund capsules save us this time, what with little from individuals. Lead-off this time is the National Academy of Engineering, to which we add another illustrious member: **Morris Cohen** of M.I.T.'s Department of Metallurgy and Materials Science. The citation reads: "For elucidation of strengthening mechanisms of steel and unification of engineering disciplines with materials science." The Academy is patterned after the National Academy of Science and shares with it the responsibility of advising the federal government in matters of science and engineering, sponsoring engineering programs for national needs, and encouraging engineering research. Election as a member is a very distinct honor, the highest professional distinction that may be conferred on an American engineer. Our most sincere congratulations, Morris.

Our irrepressible **Don Fink** comes up again with one of his good ones. Don presented a paper in November 1971 to the Northeast meeting of NEREM in Boston on the 25th anniversary of the Society. His paper was a most scholarly and philosophical treatise, on "For electronics, the past is prologue. In it Don treated the development of a number of familiar achievements such as the transistor and the laser, as evidence of how we must proceed in foreseeing future needs. Those interested in this rather comprehensive article might contact Donald Fink, General Manager I.E.E.E., 345 E. 47 St, New York City 10017.

And now this welcome material from

Alumni Fund capsules. **Stanley L. Brown** writes that he has now been with DeLuxe Check Printers for 40 years. Daughter Patricia was then a sophomore at Albright College, Reading, Pa, but come fall she will transfer to the New England Conservatory of Music. Thanks, Stan. . . . At long last we hear from **Ernesto de Sola,** of El Salvador. He is a member of the Educational Council, has been designing and building structures and has twice been a member of the council on reconstruction following two very strong earthquakes. He taught architecture at the University of El Salvador for two years; a busy fella. Ernesto, how about the family, and thanks for the note.

Now comes **Bill Conant** with a quicky. He is looking forward to the 40th, and will attend. He will retire at the end of 1972. Bill says that he is feeling mighty fine in spite of surviving three heart attacks, and still gets in 18 holes of golf, enjoys the walking and carrying the sunday bag. Many thanks, Bill. We have missed hearing from you. . . . **John McAleer** is still with the Corps of Engineers, in designing, planning and management, for coastal engineering. His lovely, Althea, is now a reference librarian, and they both enjoy their sailing hobby, out of Annapolis, on Chesapeake Bay. Glad to get your note John. . . . **Edward W. Kimbark** writes that he is President of the M.I.T. Club of Oregon, and that in September, 1971, John Wiley and Sons, published his book *Direct Current Transmission,* Vol. 1. In August and September of 1971, Ed was in Brazil, as consultant to Electricas Central de Sao Paulo. Ed is qualified for sure, as he is an Sc.D. How nice it is to hear from these boys, however seldom.

We have another heart attack victim, **Harry Summer,** in April 1972. He allows that he is back to work, and apparently feeling OK. We sure hope so. His oldest boy is a journalist and attending law school; the younger boy is still in premed. We never did get Harry's wife's name, but she is said to be bearing up well, and they both have every hope of attending the 40th. Harry, we sure hope to see you there. . . . **Courtenay Marshall** comes through with a nice bit of news. They had just returned from a 1200-mile trip to Cloudcraft, New Mexico, where they had a mountain cabin to be opened and stocked with supplies. He sneaks in with his application for the Grandfathers Club, by saying that his two young granddaughters just love the cabin and enjoy riding a coupla nags from a local livery stable. Thanks, Court, and let it be known that you may write me direct at any time without charge.

Bob Wellwood found himself on relief(?), four years ago when the F.M.C. Corp. closed down their South Charleston car shops. So he found something else, and is now connected with an importer of European underground mining machinery, and says that "an old dog can find learning new tricks quite exhilarating." He has learned to use the mining headlight on his hat. . . . Another old favorite, **Leon Hyzen,** comes through with his widow's mite. "Architectural practices still continue to grow with San Clemente. Civic responsibilities increasing and time devoted to a hobby recently resulted in a grand award at the Philatelic Exhibition in San Francisco." Good work, Leon, and please try to write a little oftener.

We have the usual few address changes, to wit: Frank Bleil, EE; John Wiley, AA; Ernesto De Sola, AR; and Edward J. Malkin, MG. These changes are available, subject to the usual admonishment: include some news of family, and you get the address.

Happily, we have had very few deaths among us lately, but we regret that we do have one occasionally. **Samuel Cauman,** AR, passed away in March of 1971. We are saddened to hear this, and are sorry that the news has come so late as to prevent our writing his loved ones, so I know you will join me in offering our sympathy here. We have no further details about Sam, however.

Rear Admiral, retired, **William E. Howard,** passed away June 14, 1972. He received a master's in naval architecture in 1933, and served in the Navy until 1956, when he retired. We are as always in deep sympathy with those loved ones who survive. I am writing his widow, the former Frances Bacon, for all of us.

Again, we deplore the shortness of these notes, but when this column appears you will already have received an interim letter of a more general nature, looking forward to our most important reunion, the 40th. This letter went to all classmates who are now what is known as active. Definition is available upon request. General Chairman Westaway of the 40th Committee has asked me to repeat his request that just as soon as you know you will attend, please tell him at once, or if you have questions, get in touch with him at the address below. That is it for this time around. I suspect that there will be a gradual loosening of economy controls, and I do hope that you will take advantage of this by writing the secretary more often and more at length.—**Warren J. Henderson,** Secretary, Fort Rock Farm, Drawer H, Exeter, N. H. 03833; **Clarence R. Westaway,** 247 Commonwealth Ave., Boston, Mass. 02116

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Let me begin by giving you the last installment of **George Bull**'s round-the-world trip. The last letter was written from Lisbon and had forebodings of a gigantic "morning after the night before." George wrote "I fly to Washington on May 11 to an accumulation of nearly four months' mail, house work (electrical and painting) and my income tax on which I got an extension to June 15.

"We were in Istanbul until April 20. While there I had a Turkish bath, a very memorable experience. Not speaking Turkish, and not knowing the word for 'stop', I ended up with two massages. They were not identical, but I am not convinced that at least one of them was not essential.

"We did conventional sightseeing in Greece and Portugal. The Corinth Canal, cut down through 80 meters of limestone by the French in 1893 is most spectacular. It is about 1½ miles long and is a most impressive slit in the earth. In Lisbon we were surprised to learn that the nearby Cabo da Roca is the westernmost point of the Eurasian land mass. Always thought it was Cape Finisterre." So the saga of the Bulls comes to an end. I hope you've found them as interesting as I did—and if George is caught up on his household chores and is looking for retirement activity, maybe he should try guidebooks. His style is far more entertaining than a lot I've read.

It is not surprising that a good deal of the news coming to me concerns retirements. From B. F. Goodrich Chemical Co. comes word that **George A.** "Bennie" **Fowles** retired on July 1 after 30 years of service with the company. Since 1964 George has been vice president for marketing for plastics, latexes and chemicals and he is retiring early at his own request. (Which makes him real smart in my experience.) Almost the entire direction of George's work with Goodrich has been concerned with the development and application of both flexible and rigid polyvinyl chloride materials. In addition to his company responsibilities, he also carried key industry assignments for the federal government. In 1956 he was named director of the Chemical and Rubber Division of the Business and Defense Services Administration for the Department of Commerce. Part of this work involved the planning for the final disposition of government owned synthetic rubber plants. George is a Fellow of the American Institute of Chemists and has been active in many technical and professional societies. He and his wife Beth live in Lakewood, Ohio, and have two married daughters.

We tend to forget that people also retire from educational institutions, but among a group of 119 retiring in July from M.I.T. was **Henry Morss, Jr.** At his retirement he was Administrative Officer of the Earth and Planetary Sciences Department.

I am sorry to have to report the loss of three more class members, two of them quite some time ago. Unfortunately, I can tell you nothing more about those two than that **William L. Reed** died in Livermore, Calif., on May 1, 1970 and that **Anthony N. Mooradian** passed away June 10, 1971 on Long Island, N.Y. The 1967 Alumni Register showed Anthony as vice president and director of Reeves Bros. Our third loss is **William B. Sample, Jr.** His brother-in-law writes that Bill died in Thomasville, Ga., on May 8, 1972. He had been with American Airlines, had been president of San Diego Telecasters, Inc., and at the time of his death he was secretary-treasurer of Atlas Hotels in San Diego. He is survived by his wife Fern, a daughter, Mary Anderson, and a sister, Mrs. Herbert Sugden. To the families of all three of these classmates we extend our deepest sympathy.

On the upbeat side is a note from Cal Mohr, '33, (who seems to help me as much as his own class) that **Art Conn** was remarried in June and expects to go to the joint meeting of the A.I.Ch.E. and the Japanese Chemical Engineers in Tokyo this fall.

I have received a number of notes through the Alumni Fund, so many in fact that I'm going to save some for next month. But from the others: **Eugene F.**

Magenau writes, "Am in Paris for a year's work in charge of working drawings and construction supervision of the landscaping portion of La Défense, a mammoth urban development project just west of Paris, on the axis of the Champs Elysees. I know that we will contribute substantially to the success of the project but doing things the French way is not easy! We have amusing—and frustrating—experiences every day."

Very briefly, Major General **Robert G. Butler** advises that his wife Mary died on April 20, 1972. Since he is living here on the Cape, I will try to present our condolences directly.

Another cryptic note from **Gerald M. Reed, Jr.**, "I've been Sailing Master at M.I.T. from 1936 to the present." To think that Gerry's working at what a lot of us try to find time to do for fun. . . . Still in the marine field, **Daniel D. Strohmeier** says "In second year of two-year term as president of the Society of Naval Architects and Marine Engineers." I don't know how many of you realize that Dan is a long-time deep water sailor. He has raced regularly in the Newport-Bermuda race, obviously for the love of it and not with any great hope of winning prizes because he is still sailing "Malay" in which he won in 1954. This year the fleet ran into a near-hurricane as they approached Bermuda, "Malay" lost part of her rigging and was forced to drop out of the race.

We've had some classmates drop in for visits during the summer. Neighbors of **Paul Wing** and Claire have a summer place practically next to us and got to see us both on one visit. They were not too long back from a trip to Yugoslavia. The other happy appearance was **Ralph Brown.** Although he is still working with the Wesson Memorial Hospital in Springfield, he and Ann have bought an old Cape Cod house not too far from us and expects to retire here in due course. He said he had seen **Johnny Westfall** in July. Johnny, still active in fiberglass specialty work, has opened another plant in Bristol, R.I., where he is making an amazingly wide range of venturi sections. Only trouble with this information is that Ralph had no idea what they were used for. Maybe Johnny will break down and let me know.

The summer hiatus in the *Review* schedule has proved a blessing to me. The Friday before Memorial Day weekend, instead of leaving for Pennsylvania to see **Eric Isbister**'s son Iain graduate from college, I landed in the Cape Cod Hospital with a moderate heart attack. I was home in three weeks but I'm still (middle of August) under some frustrating restrictions. Among them is a 1000 calorie diet —as the man on the little black box says —"Try it, you'll hate it."—**Robert M. Franklin,** Secretary, Satucket Rd., Brewster, Mass. 02631; **George G. Bull,** Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

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Priority Note: If you have not completed and returned the questionnaire sent out by Class President **Bob Forster,** please do so immediately.

It is my sad duty to report the death of three of our classmates: **John B. Meakin** last February, **Bill Abramowitz** on July 23 and **Carlos Lavenas** on July 25. John Meakin, a victim of cancer, was in Course II and is survived by his widow Dorothy living on Common St., Groton, Mass. Carl died from injuries received in a car accident in Sao Paulo, Brazil. Bill died suddenly at his home 10 Emerson Pl., Boston where his widow Lee is living. Bill's four children are scattered around the country. Bill was our 40th Reunion Gift Chairman and Class Estate Secretary and has always been active in class affairs. I first knew Bill when he was a coxswain of the crew years ago. We will miss him and Carl and John, and I know I speak for all of you in extending our deepest sympathy to their surviving widows and children. I thought it appropriate to include a poem which Bill wrote after his first heart attack several years ago because it reveals a side of Bill that few of us were privileged to know:

"How prodigally we waste ourselves.
As though the reservoir of life were limitless
And yet when suddenly it appears
As though the springs may run dry,
How much we treasure each remaining drop.
I have drunk deeply of the cup of life
And savoured with you its flavor to the very full
Should I bemoan if of this wondrous brew
I must leave undrunk a drop or two?"

Since these are the first notes written since Homecoming last June I pass along a few tidbits. Registered from our class were: John C. Alden, Mary and Bissell Alderman, Rufus Applegarth, Leo Beckwith, Ned Collins, Jane and Pete Grant, Lucille and Ollie Hoag, Bill Klehm, Mrs. Hermann Laudani, Nelson Thorpe, Fred Tone and your secretary. Rufus was just back from Southern Africa on a camera safari to Mozambique, Rhodesia and Swaziland. Oliver Hoag acquired FilmCard Corp., Pennsauken, N.J., a year ago and moved it and his home to Bennington, Vt. He is obviously enjoying it immensely. His daughter Nancy is an art major at Colorado State and taught skiing when she was a freshman at Adelphi last year. I am flying my older daughter Pamela to C.S.U. to start her freshman year in home ec and exercise her chief hobby: skiing.

The following notes were received thru the Alumni Office: **John E. Talbert** writes "Back to full-time teaching at Miami University (Ohio) after hospitalization last February. Made a speech at Society of American Value Engineers in Miami Beach last June 'Teaching Value Analysis at College Level'." . . . From **Arthur Greenblatt,** Freeport, N.Y., "Retired after many years in the galvanizing business. Now in antiques specializing in fine glass paperweights and American coin silver, selling by means of mail order and exhibiting at shows." . . . **William F. Powers** now lives in the N.Y.C. area and is a retired colonel from the Corps of Engineers and vice president of Lincoln Center for the Performing Arts. He was formerly Director of Engineering of the Kennedy Center in Washington, D.C. . . . **John D. Loomis'** *wife* writes from Worthington, Ohio for which we thank her very much: "Twenty-five years in a town that prides itself on its New England atmosphere. Twenty-two years as a *township* trustee many of which in futile battles against the 'giant' Columbus. Three daughters, three grandchildren. Hobbies: still fixing (or innovating) conveniences for his family, the fire department and boats." . . . From Bangor, Maine, Dr. **Dexter J. Clough** writes: "I've interrupted my practice this past year for a trip to the Southwest and San Diego, to take a course in ophthalmic microsurgery in San Francisco and to attend the American Academy of Ophthalmology in Las Vegas. Then for skiing the Gipfel of the Valluga and Weissfluh—St. Anton and Davos—each for a week last January. To Portugal last April for a wedding in Lisbon and some golf in the Algarve." I can add that daughter Frances was married on August 5 to John Butler, manager of the Mt. Desert Yacht Yard. In mid-August Doreen and I flew to Bangor so I could play Dexter in our second round class golf match.

We received word that the Weatherspoon Art Gallery of the University of North Carolina at Greensboro received an etching, done by a leading German Impressionist painter, from an anonymous donor as a memorial for our friend and former classmate **Edward Loewenstein** who died in July, 1970. . . . **Sid Grazi** wrote the following letter to me when I was signing him up for the 12th Annual Class Golf Tournament: "It always amazes me the lengths some people will go to in order to alibi their handicaps. First, surgery, then twisted knee and now a coronary. I hope this finds you completely recovered and I promise an adjustment without the need for this type of excuse. As a matter of fact, Green Gables has been fortunate in getting Paul Runyan as our golf pro, and I expect to spend a little time with him this year to sharpen my game and lower my handicap (with some cushion for coping with alibis). Recently had a call from Bill Abramowitz asking me to chair the Alumni Fund for this region. Needless to say, Bill is quite persuasive and can afford to be so with the fine example he sets. Talked to Irv Banquer and learned he is a world traveller and multiple grandfather. We haven't been able to compete in the grandparent field to date —not even a prospect, because our kids don't want to leave home and get married. They don't even want to get married and *stay* home. We have been doing our share of travelling, however. Our last trip included Hawaii and the Orient, and after almost six weeks, which included a few days in the Bay Area, Pebble Beach and Las Vegas, Ann didn't want to go home." I am looking forward to seeing Ann and Sid on my September trip, and hope at the same time to catch up with Otto Zwanzig again.

Harold Oshry is at the Americana Nursing Center, 2201 Cason St., Lafayette, Ind., and I am sure would like to hear from you. Harold's sister wrote Bill Abramowitz of the progress being made. I was glad to learn that Harold is one of the select group in our class that has a child nine years old or younger. Others that I know, because I have one also,

The Class of 1935 President's Trophy awaits a new golf champion.

include Jerry Golden and Dick Del Etoile. Best wishes from all of us for a complete recovery.

Among the latest address changes: Herbert Small, formerly of Waquoit, Mass., is now at 167 Los Arcos, Green Valley, Ariz.; Mrs. Faustino Andreoli now resides at 2109 NE 68th St., Fort Lauderdale, Fla.; William H. Poisson has moved from Stamford, Conn., to 325 Main St., Reading, Mass.

Robert J. Anderson has semi-retired from Filene's and moved into his brand new home at 7560 Biltmore Dr., Sarasota, Fla. 33578. I shall never forget the day he burned up the Wellesley C.C. course four years ago with a 74.

As this is written the class golf is in its 2nd round. The first cup, given by Leo Beckwith in 1960, was finally retired by Ham Dow who won it for the third time last year. The new President's Trophy will be in circulation at least until our 40th Reunion as it can only be retired after three wins.

Many thanks to you who added notes on the returns to Bob Forster. You will be happy to know I have enough material to last for a while. That news should relax the rest of you to the point where you or your wife can drop me a line about you that I can pass along to all your old friends. How else can you get in touch with so many with such little effort. Have you thought of that before?—**Allan Q. Mowatt,** Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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These notes are being written as your secretary waits at J.F.K. for a flight to Brussels. My notes from Alumni Day are in Cambridge and will be included next time.

June 24 turned out to be the only non-rainy day in the midst of days of deluge. Braving the elements were Winnie and Francis (Pete) Peterson, Virginia and August Mackro, Margaret and Dorian Shainin, Florence and Mal Graves, Vivienne and Eli Grossman. Several who didn't like the weather predictions said they'd try again. We all will. Heard from but unable to join us were Jerry Chapman, James F. (Pat) Patterson, Frank Phillips, Ariel Thomas, James O'Neil, Frank Parker, Bob Gillette, John Easton, Fletch Thornton, to name a few.

Doug Cairns is chairman of Vermont Business and Industry for the Reelection of the President. . . . **Wilfred M.** (Wiley) **Post,** manager of the Allentown-Bethlehem-Easton Airport was honored by the American Association of Airport Executives for meritorious service to the profession . . . **Henry McGrath,** our 35th Reunion Chairman, has been consulting in the petroleum and chemical industries.

Walt Squires calls attention to a change of address (not at this juncture supplied to your secretary). He writes: "Betty and I are slowly working our way north with Esso: 1970 in Spain, 1971 in France, and now it's England in 1972 (and probably 1973)." . . . **George Putnam** is now in his 14th year of operating the summer resort, Alden Camps, on East Lake of the Belgrade Chain in Oakland, Maine. . . . **Edson Snow** has been retired over two years and reports winters in Pompano Beach, summers in Rochester, N.Y.

Rufus Isaacs writes that following the attainment of a Ph.D. in math from Columbia in 1942 he was an applied mathematician (with varying official titles) in the aircraft industry, with the Rand Corp., Institute for Defense Analysis, and Center for Naval Analyses. He was awarded the Lanchester Prize of the Operations Research Society in 1965 for his book Differential Games. For the past five years he has been a professor at Johns Hopkins University.

Bill Kennedy's youngest daughter studied architecture at the University of London this past summer, an older daughter is a graduate student in anthropology at Harvard and his son Robert is doing post-doctoral research in physics at the University of Tennessee. . . . **Howard Turner,** who was a graduate member of the class, has been appointed a member of the President's Science Advisory Committee. Howard is President of the Turner Construction Co. of New York City. . . . By the time these notes are out I will have returned to normal and will be happy to hear from you.—**Alice Kimball,** Secretary, 100 Memorial Dr., Apt. 8-6C, Cambridge, Mass. 02142; or P.O. Box 31, West Hartland, Conn. 06091

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Mark down on your calendar in great, big letters June 1-3, 1973. Class President **Bob Johnson** and 35th Reunion Chairman **Paul Black** have us booked for next year's reunion at Stratton Mountain Inn, Vermont. Paul called me to tell me that this is a fantastic place, and I for one, am looking forward to seeing all of you then.

Gus Rossano writes that he has finished nine years at the University of Washington as Director of the Air Resource Program. He extends a cordial invitation to any of his classmates to visit him at his home at Bellvue, Wash. Incidentally, Gus is now listed in *American Men of Science and Engineers of Distinction.*

I have in front of me a picture of **Norm Leventhal** accompanied by Jerry Wiesner. Norm presided at a meeting in Cambridge where M.I.T. alumni pledged economic aid to Israel through Israel Bonds.

Since his retirement from foreign service, **Bill Gibson** has been working with H and R Block Executive Tax Service in the spring and selling mutual funds during the rest of the year. Bill keeps his yacht at the Corinthian Yacht Club and is active in the Coast Guard Auxiliary.

R. Gretchen Birge, after five months of travelling across the U.S. and parts of Canada has finally settled down in Sunnyvale, Calif. She has opened an interior design shop in the Town and Country Village and wonders if any of her old classmates are in the area. . . . **Eric Reissner** writes that he is now Chairman of the Department of Applied Mechanics and Engineering Sciences, U.C.S.D. . . . After 30 years in Hampton, Va., at N.A.S.A.'s Langley Research Center, **Charles J. Donlan** has moved to N.A.S.A. Headquarters in Washington, D.C. He is currently running the Space Shuttle Program which he says occupies 150 per cent of his time.

A note from **Bill McClenahan** tells us that he is now the director of the Division of Information Services at the Institute of Paper Chemistry in Appleton, Wis.—**A. L. Bruneau, Jr.,** Secretary, Hurdman and Cranstoun, Penney and Co., 140 Broadway, New York, N.Y. 10005

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From **George W. Dupree:** "am vice president—operations for Southwestern Public Service Company in Amarillo, Texas, responsible for operations, data processing, purchasing, and fuel supply." . . . Dr. **David Kaufman** wrote that he has been at Maimonides Medical Center (Brooklyn, N.Y.) for four years. His title is chief of biomedical services. In effect he is the hospital scientist with a variety of responsibilities in research and administration. . . . **Martin S. Lindenberg** is active in the U.S. Power Squadron and the New England Textile Club, and sings in amateur musical shows. His wife Mary contributes answers and puzzles to the *Technology Review* Puzzle Corner, and paints for exhibit and sale during their sailing jaunts around New England waters. . . . **Lawrence Perkins** noted that he has two daughters married to two lawyers. He now has a plant in Massachusetts as well as in Connecticut, and he is still independent, not public. "I'll make the next reunion for sure." . . . **Gilbert E. Moos** published a recent article in *Cancer Research,* establishing the isocyanates as a new class of cancer inhibitors. . . . **Myron Norman,** still in the liquor business, recently purchased a small interest in a very nice Bordeaux vineyard. He visited the property, and it has an old 29-room chateau needing a lot of work to make it livable.

J. Warren Evans has been transferred by Kaiser Engineers from Oakland to Cincinnati where he is constructing a nuclear power plant for Cincinnati Gas and Electric Co. . . . **Douglas J. Taylor** was elected Governor of the West Virginia District of Kiwanis International and for the past year he and his wife Edie have had a very busy schedule of con-

ferences and conventions both in the Kiwanis and in the sponsored youth organizations, Key Club and Circle K. They have enjoyed every minute of it! . . . **Harold Chesnut,** a consultant of systems engineering at the General Electric Research and Development Center, Schenectady, was presented in May with the honorary degree of Doctor of Engineering, by Villanova University. That is Hal's second honorary degree: he also received the degree of Doctor of Engineering from Case Institute of Technology, in 1966. . . . **Harold L. Smith** was appointed manager of the film manufacturing organization of Kodak Park Division of Eastman Kodak Company.

Attending 1972 Alumni Day were the following: George Beesley, Oswald Stewart, Mark and Carol Hyman, Robert and Sis Cotton, Mike Norman, Ernest and Yolande Kaswell, Seymour Sheinkopf, R. Wade Gaywood, Maxwell Coutts, Harold Hindman, Donald B. Peck, Frederick F. Schaller, and Walter White . . . News was received of the death of **Robert C. Whittingham,** on June 15, 1971. He lived at 31 Ladd Street, Watertown, Mass, 02172. No further details known.—**Oswald Stewart,** Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

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In the July/August issue of the *Review* the death of **John Piotti** was reported. John's career after leaving Tech until our 25th reunion was summarized in his letter to the reunion committee: "The fall and winter of 40/41 was spent working part-time and attending classes at Tech. By spring Uncle Sam was calling and ordered me to Hawaii the first of June but an emergency operation on 30 May hospitalized me for a month. In August '41 entered active duty as Zone Constructing QM in Chicago area. Spent eight months designing electrical distribution systems for ordnance plants, air fields, and training camps in Illinois, Michigan and Wisconsin. May '42 found me doing Beach Patrol Duty hunting saboteurs prior to embarking for foreign duty from October '42 to October '44 as Army Engineer. Returned stateside and spent three years in and out of hospitals until discharge in October '47. Since then have been in my own business in Dorchester at retail level dealing in electrical appliances, television and radio in both sales and service. In May '49 met Jeannette Therrien of Lynn, a nurse at Children's Hospital in Boston. We were married in November '49 and now have four girls and one boy ranging in age from 14 to 4 years." At the time of his death on May 5, 1972, John was living in Canton, Mass.

We also must report with regret the death of **Frank A. Grillo** on February 3, 1972. Frank was a member of Course VI-A and had resided in White Plains, N.Y.

During the summer several classmates have helped to expand this column. We are indebted to **Don Cole** for the following: "Having read the last Class Notes in the May issue of *Tech Review,* I am moved to write you some news about what we are doing out here in Southern Calif. A group of us, all M.I.T. alumni, having become dissatisfied with the state of the national economy, the anonymous big-company jobs, and the ruts we all tend to get into after years at the same work, have formed our own company, Technology Associates of Southern California. The idea: to apply our institutional and pragmatic knowledge and experience to areas which interest us personally and which occupy the attention of our country (except politics). There are about 50 of us at present, ranging from the Class of 1923 to the Class of 1958. I am the only undergraduate from the Class of '40. **Bill Mohlman** received his master's in 1940. All of us are, or soon will be, stockholders and corporate associates. The common requirement is that each must be an M.I.T. alumnus. We are offering consultative services in such diverse fields as civil systems, ecological studies, public safety, education, transportation, data processing, and computers, and small industry. T.A.S.C. (Technology Associates of Southern California, Inc.) was officially incorporated last Christmas Eve. Our takeoff has been the best. We not only won our first bid, but our concluding analysis of local manpower programs was sent to President Nixon by a prominent Orange County mayor, for whom we did the work. The mayor recommended that similar analyses be made in other areas across the country. It has been an exhilarating change forging our own way. One thing that has really pleased me has been the strength of the cooperation among us, although few knew each other previously. It's a going outfit and we're going further. We'll sign you up when we expand to the East Coast later this year."

Joe Greenberg writes: "A news release —I have been elected a vice president of A. T. Kearney and Co., Inc., management consultants of Chicago and 12 other cities. I have been with Kearney for eight years since I left Boynton Engineers where I was also a vice president. I am in charge of the company's engineering activities which include facilities, planning and environmental control. Incidentally, our Washington office is only a few doors away from you, at 1825 K Street. Some day I hope to have the opportunity to visit with you." Joe is also the author of an article in *Chemtech* for December 1971 titled "Systems analysis of emissions—the iron foundry industry".

Lou Michelson advises he is having a ball running his own company, Lion Precision Corp., makers of electronic micrometers, thickness gages and other industrial gages. He is now a horseback riding enthusiast and has retired from gymnastics. . . . Lieutenant Colonel **Kingsberry Jackson** is still contract relations supervisor of the Los Angeles school district. He has one daughter who has just finished her freshman year at U.C.L.A. and another graduating from high school. He sends his best wishes to the members of Course X. . . . **Clement Burnap** returned a year ago from a special assignment in London to reorganize wholly-owned Paceco engineering subsidiary. He had the opportunity to visit South Africa, Australia, Indonesia,

R. Dorsey, '40

Hong Kong and Japan—38,000 miles in 51 days. Since coming back to the states he has set up a license arrangement in Brazil and visited Moscow for the first container-crane sale in Leningrad for Siberia. He went back to U.K. in June then back to U.S.S.R. in August. . . . **Wensley Barker** writes that he is now vice president in charge of venture capital financing of a two-year-old firm in Hartford but neglects to give the name of the firm. . . . **William Overturf,** a member of Technology Associates of Southern California (TASC), writes "all members were unemployed or underemployed. The group is soliciting consulting business from local firms and civil offices." Good luck Bill. . . . **John Titherington** writes that his surgical career was ended in Portland, Maine in May 1963 because of a "stroke". He has been disabled since but plans to return to medicine soon as a part-time volunteer psychiatrist. John would greatly enjoy hearing from classmates. Address: Dr. J. B. Titherington, Shore Road, Bremen, Medomak, Maine 04551.

Bill Pomeroy since December 15, 1972 has been deputy public affairs officer, Office of Manned Space Flight, N.A.S.A. He joined N.A.S.A. in May 1963 after 17 years as a working newspaperman. . . . **Amos Joel** received the 1972 Achievement Award of the I.E.E.E. Society, Philadelphia, for his outstanding inventiveness and leadership in the field of telephone switching. Amos is a switching consultant at Bell Laboratories, Holmdel, N.J., a company he has been with since graduating from Tech. He is the holder of over 50 patents, including the largest U.S. patent ever issued. . . . **Edward Dench** is the inventor of U.S. patent 3,577,172 which was issued recently on a cold cathode traveling wave tube. Such tubes are employed in microwave radar, communication and other electronic systems. Ed has been with Raytheon Micro-Wave and Power Tube Division in Waltham, Mass., for 24 years. He is the holder of over 60 patents in the microwave field.

Bob Dorsey is the new president of the Illuminating Engineering Society. He has been in the field of illumination engineering and design since graduating from Tech, his entire career being with General Electric, where he is manager of the lighting development division in Cleveland, Ohio. Bob oversees and directs the development of new lighting and environmental design techniques, the application of new products, the demonstration teaching of illumination to all seg-

ments of the lighting industry, and the implementation of assistance in lighting design to architects, consulting engineers, designers, luminaire manufacturers, and the lighting user. In addition, Bob is the holder of a number of patents and is the author of many articles and papers in the lamp and luminaire fields. He has also contributed to the technology of street lighting and other applications of illumination for advertising and merchandising.

As a note of interest to those who missed it in the July/August *Tech Review,* two of the ten new members of the M.I.T. Corporation are classmates—**I. M. Pei** and **W. H. Krome George.** . . . Also for those who may have missed it, **Sam Goldblith,** deputy head of the M.I.T. Department of Nutrition and Food Science, has been named the first Underwood-Prescott Professor of Food Science. . . . **Herb Hollomon** is the first director of Tech's Center for Policy Alternatives in the School of Engineering. The center's purpose is to "foster the application of technology for the solution of social problems." . . . Write Al—**Al Guttag,** Secretary, Cushman, Darby and Cushman, 1801 K Street, N.W., Washington, D.C. 20006

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Our 30th reunion at Wychmere Harbor Club was a great success. We had 110 in attendance which is a record for 30th reunions in recent years. The golf and tennis tournaments were hotly contested by all and everyone got a large sack full of favors and prizes. **Jack Flipse** could not attend but sent million-year-old manganese nodules for everyone.

All of the class officers were re-elected. We did not have any problems with our Vice Presidential nominees! **Harvey Kram,** the Reunion Chairman and **Bob Greenes,** Co-Chairman were elected as additional class Vice Presidents as is our custom. At the Saturday cocktail party erstwhile crew Coxswains, **Reece Wengenroth, Jim Littwitz, Stan Golembe,** and your Secretary, exchanged current weights over a drink or two. Seems that we have gained a total of 120 pounds over our crew weights! One of the better mathematicians figures that this is only one pound per man per year.

Colonel **Ed Jess** recently retired from the U.S.A.F. and has received the Legion of Merit for his work on military weather forecasting. . . . Dr. **Frances Karlan** has been named assistant vice president and director of dental affairs of Metropolitan Life Insurance Co. Fran's son, David, has just finished his junior year at Tech. . . . **Chester Kuczon** was recently elected president of Tri-Con Associates in Cambridge. . . . **Bob Legg** has been elected a director of Talcott National Corp. . . . And still on the list of promotions, **Karl Wenk** has been elected president and chief executive officer of Intercomputer Company. . . . **Charlie Smith** has been re-elected Northern Central vice president of the Chamber of Commerce of the United States.

Bob Kraus is still busily involved in consulting on computer operations and numerical controls. He met with **Jack Williams,** head of Studebaker/Worthington, European Operations on a recent trip to Paris. Bob reports that the M.I.T. Club of Paris has over 120 paid members out of about 250 M.I.T. alumni in all of France. That is a record which should make our local M.I.T. Clubs envious. . . . **Donn Barber** writes that he has been keeping in touch with **John Lacy, Dan Hulett, Hank Henderson,** and **Bill Horton.** . . . **Gene Hanszen** spent three months in India recently as consultant for a new fertilizer plant being built in Goa. . . . **Van Alan Clark** has been elected to a five-year term membership on the M.I.T. Corporation. . . . **Alan Katsenstein** was just elected deputy general chairman of the New York Alumni Center.

That's all for now, let's hear from you.—**L. K. Rosett,** Secretary, 191 Albemarle Road, White Plains, N.Y. 10605

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The summer accumulation of "Back of the Envelope News" has arrived so here we go for another year: **Jim Casserly** reports "with Pratt and Whitney Aircraft in the marketing of hydrocarbon-air fuel cell for low pollution electric power generation. Son Jim is senior at Tufts; Patricia entering Connecticut College; Michael in third year of high school." . . . **Richard S. Fallows** says "just returned from two years stint with NATO (Air Defense). Still working at Mitre Corp. Oldest daughter just finished sophomore year at Tech." . . . **John W. McDonough, Jr.,** notes that he was "recently appointed product manager for Lumber Handling Division of Irvington-Moore, a division of U.S. National Resources, Menlo Park, Calif." . . . Captain **Carleton F. Bryant, Jr.,** scribbles "we'll be living in France for the next year or so. I am working as a naval architect for the J. J. Henry Co. and representing the El Paso Natural Gas Co. in the construction of three very large liquified natural gas tankers at a Dunkerque shipyard."

Another deciphered note from **Bert E. Picot** and **Martin H. Winter** reads "have formed a systems service company to provide photographic identification card systems for schools, universities, banks and government agencies." Our classmates ask us, "Are you interested as a client or a potential investor? A stock issue is brewing so write Bert Picot, Pico Card Systems, Forest Hills, N.Y. 11375." Here's hoping your computers can read your handwriting, Bert. I can't.

John H. Moss, reports "am Professor of Geology and Director of Environmental Studies at Franklin and Marshall College. Also, am President of the Lancaster Environmental Action Federation (LEAF) and a member of the Board of Pennsylvania Environmental Council." . . . Another chap with similar interests, **Churchill K. Wilcox,** writes "Having been a special graduate student at Tech this past year, I hope to enroll in a Ph.D. program in environmental science this fall. I've been teaching part-time at Harvard and Tufts for the past two years, in natural science and air pollution control, respectively. I hope eventually to obtain a full-time position at M.I.T. to carry on my research on climatological effects of carbon dioxide." So ends the personals, so to speak. It would be nice if we could have more letters to the lonesome class secretary. How about a report on the vintage wines of France, Carl Bryant?

The Board of Library Trustees of the Newton Free Library reports the election of **Arthur E. Vershbow** as chairman. Our classmate is an officer and director of Modern Die and Machine Co. of Boston. . . . **Stanley B. Conklin** of Freehold, N.J., has been elected president of the TB-Respiratory Disease Association of Central New Jersey. He is coordinator of science education for the Freehold Regional High School District. . . . **James B. Reswick** has been elected to the Institute of Medicine of the National Academy of Sciences. New members are selected for major contributions they have made to the broad, general fields of medicine and health care in such areas as health care delivery, prevention of disease, education, biomedical research, and the philosophical and ethical issues of concern in health care delivery. Our classmate is Director, Rehabilitation Engineering, Rancho Los Amigos Hospital, Downey, Calif. Personnel of this center have designed and developed a number of innovative devices for severely handicapped patients, which restore function to weakened or paralyzed muscles through electrical stimulation.

A bulletin from the National Bureau of Standards reports that the N.B.S. Law Enforcement Standards Laboratory (L.E.S.L.) is now directed by **Richard B. Morrison.** The L.E.S.L. is mounting a comprehensive program to better equip law enforcement officers in their constant battle against increasingly sophisticated crime. The laboratory is serving as a technical resource aiding in the formulation of standards recommended for voluntary use by local, state, and federal law enforcement agencies and equipment manufacturers. There you have it, classmates. . . . a "low-gear" first effort for the new season. My next personal letter received will be the second one of 1972! Who would like to do the honor?—**Jack Kelly,** 34 Scudder Road, Westfield, N.J. 07090

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Although it is only mid-August I suspect we should be wishing you Happy Thanksgiving or at the very least a pleasant Veterans Day! By now you should have heard from either Prexy **Tom McNamara** or Class Agent **Bob Maglathlin** as respects our Mini Reunion April 7-15 in Spain. It is not too early to plan this Safari and we look forward to seeing you at that time.

Alumni Days 1972 attendees were Charlie Benfield, Freida Osmansky Cohen, Dee and Frank Gallagher, Nancy and Charlie Hart, Bill McKay, Ann and Bob Maglathlin, Art Miller, Warren Miller, Carolyn and Jim Pickel, Warren Smalzel, and Fran and myself. At Pops time Sunday evening Greater Boston saw one of its most spectacular thunderstorms; during its height Frank Gallagher kept a bus

At the Annual Banquet of the Institute of Electrical and Electronics Engineers held on March 22 of this year, the awards list was sprinkled with many M.I.T. names. Of the six major award winners, four were M.I.T. alumni. Above, I.E.E.E. President Robert H. Tanner presents Jay W. Forrester, S.M.'45, (left), the Medal of Honor, the organization's highest award which recognizes a clearly exceptional contribution to science and technology—in this case, Professor Forrester's "exceptional advances in the digital computer." Other major award winners were: to Mac E. Van Valkenburg, S.M.'46, the Education Medal; to Yu H. Ku, '25, and to Robert H. Park, '23, the Lamme Medal. In addition to the major awards, 13 more M.I.T. alumni were awarded the grade of Fellow of the I.E.E.E., and a prize award, the 1972 Browder J. Thompson Memorial Prize for the best paper published in an I.E.E.E. publication, was presented to G. David Forney, Jr., Sc.D.'65.

load of us in hysterics as he teased the girls, young and old alike. One of these years we shall have to give Warren Miller a prize for I doubt whether he has missed a day in 27 attempts.

Bill McKay continues as a partner at Pettingell Associates in Waltham despite (!) his relocation—Cape Cod—after a lifetime in Greater Boston. Bill, most people don't realize that Cape Cod, like New Castle, N.H. this day and age is really Greater Boston! . . . Last spring we told about **Art Hall**'s leaving for seven years in Iran; we now have a few comments made by Art in a mid-May letter: "Everything is different here, the women cover their faces, yet mini skirts are still seen. Some other points are: (1) locks turn clockwise to unlock; (2) Grades go from 13 to 1; i.e. an 18-year-old is frequently in the second grade; (3) the writing goes from right to left; (4) a good lie i.e. one well told, is a praiseworthy thing; (5) always bargain; (6) the spoken word is more valuable than a written contract—sounds like matrimony!"

Fred Lehmann reports that his family enjoyed Ann and **Bob Maglathlin**'s hospitality on Prince Edward Island during the early July total eclipse. As many of you know Ann's family are from the Island. . . . Louise and **Tom McNamara** sang the Stein Song in the Casbah in Casablanca Alumni Day; a little business and lots of vacation we suspect. . . . Wil and **Curt Beck** of Pampa, Texas, represented the Class at last year's Fiesta in Mexico; possibly others of you will attend the 25th Fiesta in mid-March 1973. . . . **Bill Blitzer** was elected president and chairman of the executive committee of Lightolier Inc. in mid-June. Lightolier, located in Jersey City, is a leading manufacturer and designer of lighting fixtures and portable lamps. Are you still racing your Rhodes, Bill?

Bob Harris heads the Advisory Services Program at the University of Washington, one of the first four Sea Grant Colleges. . . . Bells, bells, bells! **Jim Speaker** finally got married—two years ago; his wife Ann has three children: 12, 15 and 19. . . . **Ed Malloy** is most active in Boy Scouts and American Legion in South Carolina. . . . **Isaac Goodbar,** is a Fellow, Illuminating Engineering Societies (U.S.A. and Great Britain).

R. Duncan Luce was elected to membership in the National Academy of Sciences this spring. In July Dunc left the Institute for Advanced Study in Princeton to become Professor of Social Sciences at the University of California at Irvine. . . . **William Linvill** of Stamford University, as a representative of the National Science Board, testified before the House Committee on Science and Astronautics on the problems and needs of American technology in the industrial and social sections in late April. . . . On the same date, **Hugo Perez La Salvia,** Minister of Mines and Hydrocarbons of Venezuela, presented a most interesting paper, "Venezuelan Oil Policy," at the Pan American Society of New England in Boston. . . . Until next time—**Clinton H. Springer,** Secretary, P. O. Box 288, New Castle, N.H. 03854

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I am very sorry that we did not develop a column for the May issue of the *Review*. Regrettably there was no material from which we could write the notes. We desperately need you people to send us news if we are to write concerning classmates' lives and activities.

There was a very interesting article in the *L.A. Times* in May concerning our classmate, **Generoso Pope, Jr.,** under the dateline of Lantana, Fla. Generoso is owner-publisher of the national *Enquirer* paper which is sold at supermarkets and other newsstands, and has grown in circulation to 2.6 million, exceeded only by *TV Guide* in newsstand sales. For 15 years the magazine packed its pages with gore, stories of the grimmest and most macabre nature that could be found. The editorial policy was simple, the more gruesome the better, and this policy ruled for 15 years until circulation stalled at a million. Six years ago Generoso decided to move his paper into a better field. An abrupt change in editorial policy was made: from gore and murder, to such subjects as peoples' personal success, scientific discoveries, and predictions of Jeanne Dixon. Following a drop in circulation to 700,000, sales have increased to over 2.6 million and the editors confidently expect sales to reach 5 million by 1975. Part of the success is due to the recognition by Generoso and his staff of what people are interested in reading and not what editors think the readers should be interested in.

Gene is a perfectionist, the *Times* article continues, and must approve every story idea and finished draft. Recently at a meeting someone suggested that each writer should hire his own reporter to be sent around the world in search of unusual and off-beat articles. Gene unhesitantly agreed to the idea even though it will cost $600,000 annually.

Gene edited his father's Italian language *Il Progresso* in New York City and then, in 1952, bought the *New York Enquirer,* a racing sheet with a circulation of 17,000 for $75,000. Then began the story-book growth of the paper we have described above. In the summer of 1970 Gene moved his operation from Englewood Cliffs, N.J. to a new $1.5 million plant on 7.5 acres of land at Lantana, Fla. The *Times* reports that Gene, asked where he goes from here, just beams and says, "Up."

Mason Lappin graduated from M.I.T. in 1946 and 1947 with two B.S. degrees and is a registered professional engineer. He is president of the Master Plumbers Association of greater Boston. Mason has long been active in Boston community and business affairs. He was recently honored in an installation as president of the Greater Boston Chapter American Society for Technion, the Israel Institute of Technology. . . . **Gifford H. Stanton** has written a short note. He and his wife, June, have settled in Paget, Bermuda, where he is marketing manager for leading liquor and wine merchants. June is busy running a guest house business and is also involved in real estate and interior decorating. Gifford's hobbies are tennis and collecting clocks. . . . **Ernie Buckman** of Pittsburgh, president of Oliver Tyrone Corp., a large developer and owner of office buildings, is running for delegate to the Republican National Convention in Miami. Ernie served as an alternate delegate to the convention in

Here they are: members of the Class of 1947 gathered for their 25th Reunion photo in Cambridge, June, 1972.

1968.

Dr. **John L. Bateman** began a 16-month appointment in the Department of Internal Medicine, Section of Oncology, at Lahey Clinic in Boston. John says he is enjoying his new proximity to his old alma mater. . . . **John L. Norton** has moved to Cincinnati, Ohio, from Greenville, S.C., following his transfer by G.E. to manager of test for large gas turbines. . . . **Frederick J. Ross, Jr.**, group vice president of Carborundum Co., has been elected a member of the executive committee of the American Supply and Machinery Manufacturers Association, Inc.

A sad note that **Charles H. Gray** of Etna, N.H., died on September 4, 1971. We have no further information on this unfortunate event.

Please send us a short letter on your recent activities. Until next time—**Russ Dostal**, Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

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It is now quite a while ago but we had a very enjoyable 25th Reunion on campus at the beginning of June. Those who put in an appearance were as follows: Harl and Lois Aldrich, Jordan and Rhoda Baruch, Tom and Ellen Bell, Paul and Phoebe Bock, Claude and Mary Brenner, Dan and Gail Carnese, Bart and Helen Carmody, Harry and Jean Cavanaugh, Morgan and Daphne Cooper, Tom Crow, Bob and Mary Devine, Fred and Joan Ehrich, John Ebersberger, Walt Ericsson, Steve and Eve Evans, Hy and Rosalie Fisher, Alex and Carter Giltinan, Virginia Grammer, Sid and Edna Grob, Hugh and Lori Flomenhoft, Bob Hagopian, Vince and Adelaide Haneman, Mike and Doris Hardy, Ray and Willie Hasse, Fred and Mardi Heuchling, Scott and Dolores Hoehn, Bob and Carol Horowitz, Arnold and June Judson, Burt and Betty Kahn, Ed and Mary Lou Kistner, Jim and Ethel Kyle, Wally and Carolyn Lack, Jack Leonard, Byron and Nan Lutman, Mort Lowenthal, Ken and Lois Marshall, Jack and Nancy Martin, Bill and Kay McClelland, Bill and Virginia McCurdy, Tom and Sue McEvoy, Dick and Betsy Mooney, Paul and Jeanne Moschella, Aaron and Florence Newman, Alex and Adele Pastuhov, Jim and Janie Phillips, Marty and Jan Phillips, Dick and Dottie Potter, Jim and Arlene Prigoff, Al Richardson, Jack and Mary Rizika, Ed and Harriet Rosenberg, Paul and Mary Schilling, Bob and June Slusser, Leon and Florence Scharff, Irv and Marge Schwarz, Art and Marge Schwartz, Bob and Claire Seidler, Parker and Midge Symmes, Arnold and Vera Varner, Fred and Cornelia Veith, Walt and Betty Weeks, Don Van Greenby, Gina and I, and about 80 children. Trust that my list is complete but some people due to other reunions, graduations, etc., came and left. I wonder how many you recognize in the photo at the top? Some are obviously missing including Byron Lutman and yours truly who were golfing together for the first time in 15 years.

For those of you who were not able to attend and as a refresher for those who were there, we'll give a brief resume of activities. Friday afternoon we checked into McGregor House, one of the new dorms on the river near what used to be the Smith House. The rooms in this dorm are all singles so desks had been removed and a second bed installed for our accommodations. The bath down the hall didn't get too crowded and the accommodations, though not up to the best motels, are certainly far better than the old dorms of our day. Cocktails preceded a very fine buffet dinner followed by an open bar. The students serving the meal allowed as to how we were eating much above their normal fare. **Al Richardson** opened the bar for cocktails and **Jack Leonard** and I closed it at midnight. It was a joyous time of renewing acquaintances, meeting people for the first time and conviviality for all. Subjects discussed really ran a wide gamut and as I write this I recall only Leonard and I getting far out of our depth arguing women's lib with Arlene Prigoff.

Saturday was highlighted by a reception at the president's house with Drs. Gray and Wiesner and many profs from our time. The afternoon was open for sailing, tennis and other activities. I understand that the Seidlers, Horowitzs and others played quite a bit of tennis over the weekend. It is only hearsay however. The day ended with cocktails and a dinner dance where much of the music was vintage of the 40s.

Sunday provided a cruise around Boston Harbor with a clam chowder lunch. We tried hard but we never did get **Parker Symmes** to jump overboard and take lobsters from the traps. Much cheaper on the treasury doing it that way. That evening was Tech night at the Pops with Arthur Fiedler still doing his marvelous job. Our beautiful weekend weather was disrupted by a torrential rain as we were leaving the buffet dinner at the Sala de Puerto Rico and heading for Symphony Hall. Many became a bit damp running from the Stratton student center to the buses.

Monday was Alumni Day, highlighted in our minds by the fact that **Dick Mooney**, our reunion gift chairman, was able to present a new record for a 25-year gift at the Rockwell Cage luncheon. We had 439 class members contributing $728,593. Thanks to Dick for a job very well done.

The children were housed in Baker House and kept very active by their counselors with a program of swimming, softball, sailing, etc. They all appeared to enjoy the activity and food to the extent that a few were observed napping

in the more sombre period of the Pops.

Our thanks to the reunion committee chairmen, **Arnold Judson, Bob Horowitz, Sid Grob, Fred Ehrich, Al Richardson, Claude Brenner** and **Parker Symmes.** I believe that all who attended enjoyed the festivities and look forward to attending another one. For those of you who could not make this one, there was mumbling of 1977 in Bermuda.

At Saturday's dinner a few awards were made: *Youngest:* **Art Schwartz**—no contest whatsoever; *Baldest:* **Don Van Greenby,** I think, was given the award over **Aaron Newman** but there were very few hairs difference; *Farthest Trip To Attend:* **Steve Evans** from Brussels, Belgium but **Art Schwartz** from Irvine, Calif., had to be a close runner-up.

A note from Ian Clark, 61, President of the M.I.T. Club in Mexico City invites us all to their 25th annual Fiesta to be held March 15-17, 1973.

Am pleased to report that Gina and I kept the ball in play and had an 82 net 67 in the district Scotch golf event earning a second net with the area hot shots. Drop us a line.—**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

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In June Alumni Day was attended by the following members of our class (note: wife's name depends on my memory): Charles and Shirley Adams, William H. Ayer, Dick and Joan Baker, Dick Berry, Bob Bliss, Ken and Ann Brock, Matt Doyle, Ed Hanley, Karl Justin, Mel and Sylvia Berkowitz, George and Mary Agness Clifford, Leon and Rose LaFreniere, Joseph M. Rault, Norman and Dorothy Seltzer, Milton Slade, Robert Turkington, Backman Wong, Verity and Anita Smith, Ted Yoos, Sonny and Gloria Monosson, and yours truly with my daughter Amy.

On Sunday afternoon before the buffet that preceded Tech Nite at the Pops, our class had a cocktail hour in the Green living room at McCormick Hall. Joe Rault whose invitation to the cocktail hour probably arrived in New Orleans just as he was leaving for Cambridge, attended along with Sonny, Verity, Ken, George Clifford, Bob Bliss, Norman Seltzer, Dick Baker, and yours truly. Wives, guests and a few friends from '46, '47, and '49 rounded out the gathering in the beautiful decor of the Green room on a lovely spring afternoon.

Gordon Johnson was chairman of the Symposium on Unconventional Photographic Systems last October. In May he received an award as Senior Member, Society of Photographic Scientists and Engineers. Gordon's four children range from 10 to 15 years and his family lives in Alexandria, Va. . . . **Allen Amdur** is commuting from Summit, N.J., to Puerto Rico for E. R. Squibb. Allen was in R and D at Allied Chemical for 13 years and in engineering at Scientific Design for 9 years. He and his wife Marilyn have a married daughter and one son who lives at home. . . . **Buckley Collins** was re-elected in November 1971 to his fourth term as city councilman in Port Huron, Mich. Buckley has been a member of the City Planning Commission since 1965. In 1971-72 he was president of the Blue Water Chapter, Michigan Society of Professional Engineers.

Edward Mack, 3rd, recently moved to Milwaukee, Wis. Ed joined J. G. Milligan Co. as latex and solvent adhesion chemist. He and his wife Elizabeth and son Edward, age 4, are getting adjusted to the Milwaukee area. . . . **Arnold H. Smith** moved from Daytona Beach, Fla., to King of Prussia, Pennsylvania. He tells us that his furniture was in storage and he'll never do *that* again if he can avoid it. Arnold is still with G.E. and currently is manager—procurement systems for Reentry and Environmental Systems Division of G.E.'s Aerospace Group. His daughter Diane, 22, graduated from Wilson College in 1971 with a B.A. in sociology and is doing graduate work for a degree in guidance in upper education. His son, 21, is still trying to decide what he wants to do. Two more sons (16 and 14) in the hangar. His wife Marge is assistant librarian at Ambler, Pa. and loves it. His daughter's marriage to a '71 U.S.N.A. grad is planned for September 2, 1972 at the chapel at Annapolis. Arnold is continuing his work on the Education Council.

Spero Paul Daltas is a partner in the firm of Brown, Daltas, and Associates with offices in N.Y., Rome, and Kampala, Uganda. They have completed a new 10,000 student campus for Rangoon University. In Uganda they completed four regional teacher training colleges for 4,000 students. Spero's firm is continuing work on State University of N.Y. in Farmingdale and projects in Saudi Arabia, Turkey, Italy, Germany and Uganda. . . . **Donald Floyd** retired from the Air Force two years ago. At present he is employed in the office of the Assistant Secretary of Defense, Internal Security Affairs—trying to "sell" a foreign assistance program to an increasingly reluctant congress. . . . **Jim Guida** is completing 31 years of federal service. As I understand his plans he expects to retire in June 1973.

Phil Friedlander died January 4, 1972 in Mass. General Hospital after a brief illness. With the aid of Stan Fingerhood I contacted Pete Richmond, '46, who drafted this note. Phil left his wife Ellen and five children, Lisa, Paul, Katherine, Lynn, and Frances of 39 Devon Rd., Newton, Mass. Phil was active in the retailing industry for most of his life and recently spent two years in Israel ('67-'69) as an industrial consultant with Israel's Productivity Institute. His warmth, ebullience and energy will be missed by his many friends.

Joe Yance responded to our missing persons bulletin. (See May issue.) Joe assured us that the Alumni Fund did not consider him missing—they contact him regularly at 13 Worcester St., Belmont, Mass. 02178. Karl Justin and Dick Harris who had asked me to help contact Joe can add to their data bank that Joe reads our class notes. I am personally pleased to receive Joe's response to the column, since there are only a few letters from classmates every year.—**S. Martin Billett,** Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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A week of cool, dry air has just ushered in August, giving hope that the summer is not totally lost to heat and humidity. I wish for all of us a beautiful autumn season to make up in part for the miserable spring and summer we have had.

The Annual Class Cocktail Party, held on Sunday of Homecoming Weekend, has drawn 10 classmates, almost all with wives, in each of the last two years. In 1971, Messrs. Russ Cox and Malcolm Kurth alone came solo. Everyone else was spoused. Frank Hulswit, Demetre Ligor, and Kemon Taschioglou were present in 1971. Peter Cambourelis, Alex D'Arbeloff, Willard Heintz, Harry Lambe, and Yenwith Whitney attended in 1972. Ed Berley, James Critser, Stan Margolin, Charles Sutherland, and Paul Weamer made it on both occasions. Our thanks to Stan and Harry Lambe for making the latest arrangements.

I have received two letters this month, a delightful and almost unique happening. **David K. Hardin** writes, "Your column reads so well that I figure my old friends must be reading it. So, I thought perhaps that two pieces of information might be appropriate: 1. I'm becoming President of the American Marketing Association on July 1, 1972 for a year. My swan song. 2. I'm going to Seabury-Western, the Episcopal Theological Seminary on the Northwestern University Campus, on a special moonlighting program that lasts for two years—half-way through. A new career, maybe. Thanks for your great service for our class." (Thank you very much for your kind words, Dave, it's nice to know when one's work is appreciated.) By another coincidence, both letters involve references to religion. **B. J. Kirkwood** writes, "While attending the National General Assembly of the United Presbyterian Church in May, I happened to sit at dinner next to a man on the national church staff, dealing with the denomination's foreign missions. He came to that position after several years teaching math and sciences in the French Cameroons, which in turn followed a stint with Republic Aircraft on L.I. Intrigued at the variety of vocations, I inquired into his background and discovered he was **Yenwith Whitney,** '49! Rather unusual micro-mini-reunion, no? Beyond this, I have little to report. Still (18 years) in consulting engineering, mostly on municipal utilities and operations. Regularly see **Lou Rasmussen** and Bob Hutton '50 (and a neighbor), who are present officers of the M.I.T. club of Kansas City. Five offspring range from 8th grade to college senior (Macalester), with one in Navy and one taking a sabbatical working in a church study center in Germany before heading to college. Keeping my thumb in the M.I.T. pie as educational counselor—and looking forward to 1974's 25th." Those of you who read this column regularly will remember that Dave Hardin is president of Market Facts, Inc. in Chicago. B. J. Kirkwood is a partner in A.C. Kirkwood & Associates, in Kansas City.

Next, ten Alumni Fund notes: **Fred Buttner** "spent a busy but enjoyable two

months in Iran studying the mining industry for a long-range development program." . . . **Jabez** (Stoney) **Harford** reports that he is still with the Niagara Blower Company in the Chrysler Building in New York City and asks **Milt Bevington** to get in touch if he ever gets to New York. . . . **Archie Harris** enclosed a press release announcing his appointment as Planning Assistant to the Vice President—Marketing Group of Leeds and Northrup Company, North Wales, Pa., makers of electronic instruments and process control systems. Archie says, "it's good to return to the East Coast. Son, Ken, graduated from University of California and daughter, Diane, was married last year. They are still on the West Coast. I'm happily married to the former Doris Morrison of Newport Beach and will be at home in the Lansdale area." . . . **Demetre P. Ligor** reports in as President of Applied Measurements, Inc., Acton, Mass., which is celebrating its 10th anniversary as New England Manufacturers Representatives for sensors and electronic instrumentation used in measurement and control. . . .**Gregory Lynes** was "remarried in June 1970 to Jean Fox (Riley) of Washington, D.C. and got four additional and delightful children in the bargain. Now 'between jobs,' doing small amount of private consulting in management practices. Hoping to enter government service as an internal consultant, Department of Interior, with emphasis on systems approach to management of ecological environment." . . . **Dick Perley** recently joined the Kaman Aerospace Corporation as technical director of the Systems Management Department. . . . **John H. Pomeroy** (Ph.D., chemistry, 1949) reports "I am administering the research programs of the lunar rocks and samples from the Apollo Programs." . . . **William P. Reynolds** "decided to start a bank as the only sure way to become a Director: the Neponset Valley Bank and Trust Company in Canton, Mass." . . . **Charles M. Sutherland** served on the Minuteman Regional Vocational School Committee for the past year and has just started a three-year term on the Weston School Committee, a fascinating but time-consuming job. . . . **Norval C. White** ends the fund notes with "since July 1970, I have been professor and chairman of a new and burgeoning Department of Architecture at City College. We are attempting to face the problems of the immediate, real, urban society with a large, populist student population." Based on some of the adjectives you use, Norval, the job sounds far from dull.

In connection with his most recent appointment, a press release reviews **Marvin A. Asnes'** career. After getting his B.S. degree from M.I.T., Marv obtained an M.B.A. from Harvard. In 1964, he was executive vice president of Clay Adams when that firm was acquired by Becton, Dickinson and Company. The following year he was elected to B-D's board of directors; in 1966, he was appointed president of the Company's Laboratory, Science and Education Division. He was named group vice president in 1968 and was appointed an executive vice president in May 1972. Residing in New York City, Marv is a trustee and treasurer of the Bank St. College of Education in New York City; a member of the Visiting Committee, Sloan School, M.I.T.; a director of Stanley M. Isaacs Neighborhood Centers in New York City; and a member of the Harvard Club.

Finally, A. H. Robins Company announces that **A. Stuart Powell, Jr.,** has become vice president and general manager of Caron Corporation of New York City, the U.S. subsidiary of Parfums Caron, Paris-based subsidiary of A. H. Robins Company. (That's a multinational company with a vengeance.) Powell is a former president and chief operating officer of Concept Publishing Company, publishers of *Beauty Fashion, Cosmetic World,* and *Department Store Management.* He helped form the marketing and economics division of the American Chemical Society, and has held positions in the Chemical Market Research Association and the Chemical Industry Association.

That seems like enough for this issue. I'll hold over the rest, including a delightful birth announcement, until next month. See you all then.—**Frank T. Hulswit,** Secretary, 77 Temple Road, Concord, Mass. 01742

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Charles F. Grice reports that after 17½ years with Schlumberger Well Services, he left to organize Grice Ocean Engineering, Inc. (G.R.O.E.) in 1968. "Survival" during the past few years has been difficult, but the venture is still alive. . . . Returning from an architectural seminar last October, **Frederick F. Sadri** stopped via Chicago and paid a most enjoyable visit to **John M. Hetherington,** Course IV-50. They rehashed the 20 years gone by—looking forward to 25th reunion.

Sincere sympathy and condolences are offered to the family of **Benjamin H. Downs,** who died on February 14.

Myles S. Spector was just reelected Treasurer of Hackensack Meadowlands Development Commission for ensuing year. He has been on the Commission by appointment of the Governor since its inception in March of 1969. The commission is charged by the legislature with the orderly and balanced development of the 20,000-acre Meadowlands District and is concerned with everything from land use to solid waste disposal to architecture, etc. On March 30, 1972, Myles was elected President of Seaboard American Corp. of Flemington, N.J., (O.T.C.). It's a diversified company in the food and housing fields. . . . **James W. Geiser,** Vice President of Allegheny Power Service Corp., in Greensburg, Pa., was graduated from the Advanced Management Program of the Harvard University Graduate School of Business Administration in May. He had been studying at the Business School since February 6.

Rui J. P. De Figueiredo, Professor of Electrical Engineering and Mathematical Sciences at Rice University, will be spending his sabbatical leave for the academic year, 1972-73, at the Mathematics Research Center, University of Wisconsin, Madison, Wis. . . . During the month of July, Dr. **Sanford C. Spraragen** moved to Rhode Island to assume the positions of Director, Nuclear Medicine at the Miriam Hospital and Associate Professor of Biological and Medical Sciences at Brown University. He and his wife, Bobbie, have four children. . . . **Eli I. Goodman** reports that he and his family have just returned from Tokyo's A.E.C. office. Now working on energy policy matters in A.E.C.'s Office of Planning and Analysis which reports directly to Commissioners. All five Goodmans absorbed lots of language and Japanese culture and would welcome further overseas assignments.

Charles E. Hepner tells us that he is one of the growing number of middle-aged career changers and reports that four years after graduating from Yale Law School, he is enjoying the practice of patent law immensely. His wife, Anne and children Robert (10) and Elizabeth (4) and he live in an old farmhouse in Southport that is worth the two-hour commute, door-to-door. . . . **Hansjoerg Stern** is heading up G.E. Co.'s fluidic controls business and is living in Schenectady, N.Y. His family enjoys the winters of Upstate New York—oldest daughter, Gail (g. M.I.T. 1949) married in nearby Hadley—Christopher 12; Karen 5; and wife, Mary, ski in winter and travel summers to visit grandparents in Austria and California. Hans is now flying for a hobby. . . . **John G. King,** Professor of Physics, was the commencement speaker at the 15th graduation exercises of the University of Hartford on May 27. . . . **Samuel O. Raymond** and Gary Hayward, '58, are the inventors of a new electronic inspection device known as "Tap Tone." This is a portable electronic device for checking the condition of cans and jars inside sealed cardboard cases: taps on cans electronically; frequency of tone heard indicates degree of pressure or vacuum in can. Both Hayward and Raymond used to work for Harold Edgerton at M.I.T. and now work together at Benthos, Inc., of which Raymond is president.

Carl F. Long, Professor of Engineering, has been named Associate Dean of the Thayer School of Engineering and Chairman of the Department of Engineering Sciences, the division of the 101-year-old graduate school that offers engineering courses to undergraduates. Dean Long has been a member of the Thayer School faculty since 1954 and holds baccalaureate and master's degrees from M.I.T. and a doctorate in engineering from Yale. . . . **Douglas C. Cook** has been appointed manager of the special products division of Caterpillar Tractor Company. He has been with the Caterpillar Company since 1967 and has been manager of the GOER program in Defense Products since 1970. . . . Dr. **Peter G. Dayton** has been promoted to full professor at the Emory University School of Medicine. He also holds an appointment as associate professor of chemistry and has been at Emory since 1967. He had previously held appointments at New York University School of Medicine and at the National Heart Institute, Bethesda, Md. He received his Ph.D. in 1953 from the University of Paris.—**John T. Mc-**

Kenna, Jr., Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

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The 20th reunion of the Class of '52 is now history. The weather smiled upon over 100 class members and their families at what has often been a foggy Martha's Vineyard. On the second through the fourth of June, it was as sunny and nice as one could ask. Everyone present enjoyed themselves shopping, sailing and bicycling and all were particularly impressed with the facilities of the Harborside Inn, the ideal place for a class reunion. During the short business meeting, those present selected **Mike Nacey,** Class President for the next five years, **Arnie Kramer,** Chairman for the 25th Class Reunion, **Stan Sydney,** Treasurer and Class Agent, **Arthur Turner,** Class Secretary and **Dick Lacey,** Assistant Class Secretary.

Stan Zisk writes that he has been working as a radar astronomer at Haystack Observatory at M.I.T. His work includes moon watching (measuring surface, roughness, tilt and elevation) and considerable contact with the Apollo program. He has also been dipping into geology and geomorphology. . . . **Gerald Cohen,** currently senior engineer at McDonald Douglas Corp., recently received an M.B.A. degree from the University of Southern California and was elected to Beta Gamma Sigma, honorary business administration fraternity. . . . The Department Chairman and Professor of Aerospace Studies at California State University, San Francisco is Lieutenant Colonel **Brian G. Moore. . . . Ronald C. Chisholm** is starting at M.I.T.'s Sloan School in a one-year accelerated program leading to a master's degree in management.

A note from **Francis A. Zuccardi** says "I have been in Albany for almost ten years working on a massive building program for the State of New York (State University Construction Fund) designing and constructing large university complexes. It's lots of work and I'm still having fun at it." . . . **Charles F. Springer** has just returned to the U.S.A. after completing an overseas assignment as project director constructing a new dyestuff manufacturing plant for the chemicals group of Crompton and Knowles Corporation. He is returning to his former position as chief engineer at Althouse, a Division of Crompton and Knowles, in Reading, Pa. . . . **Arthur H. Heinzman** is a structural engineer, living in McLean, Va., with his business in Washington, D.C., the consulting firm of Heinzman, Clifton and Kendro. . . . Continuing as director of Toledo do Brasil, an affiliate of Reliance Electric Company, is **Ricardo E. Haegler.**

The I.E.E.E. has elected **Thomas E. Stern** a Fellow for his contributions to nonlinear network theory and engineering education. . . . The B.P. Oil Corporation has announced the promotion of **William P. Chandler** to the position of manager of administration. Previously, he had been BP's manager of operations control. He has been with the company since it was formed in 1969 and lives in Atlanta, Ga. . . . The Office of the Surgeon General, U.S. Army has announced the promotion to Colonel of **Harold R. Larson.** Colonel Larson has a D.D.S. degree from Loyola University Dental School and interned at Hynes Veteran's Administration Hospital, Hynes, Ill. He has served as division dental surgeon with the 101st Airborne Division, Fort Campbell, Ky., and has completed a two-year residency in general dentistry at Madigan General Hospital, Tacoma, Wash. His new responsibilities are as chief of the division of professional development at the U.S. Army Institute of Dental Research at the Walter Reed Army Medical Center. He and his wife and four children live at Burtonsville, Maryland. . . . **Douglas F. G. Haven,** past president of the Class of '52, is a financial service consultant working from his home in Wellesley, Mass.

I.B.M. has announced the promotion of **Jere L. Sanborn** to senior engineer, responsible for the planning and coordination of design automation development at the Poughkeepsie Laboratory of I.B.M.'s systems development division. He holds four patents for superconductive circuit design and is co-author of a chapter on logic design in the *Digital Computer Users Handbook.* He and his wife, Audrey, and their three children reside in Poughkeepsie, N.Y. . . . **Robert F. King** has been named to the position of national sales manager, Industrial Commercial Products of the Fram Corporation. He will be responsible for the direction of regional offices in Newark, Chicago, and San Diego and will have his headquarters in Henderson, N.C. . . . **Jack A. Mankes** writes that he has recently been director of a Department of Labor sponsored Vest program in Philadelphia. He is now acting as job development consultant for the state of Pennsylvania. . . . **Werner E. Sievers** has been named technical director of the Defense and Surveillance Systems Division, MITRE Corporation.

Robert H. Norton, C.L.U., has been named to the Presidents Honor Club of the John Hancock Mutual Life Insurance Company for the second time. He has qualified three times for the Million Dollar Round Table. Bob, his wife Ginny, and their eight children live in Hollliston, Mass. . . . **Vincent LoCicero** is partner and general manager of New England Laser Company in Billerica, Mass. Previously, Mr. LoCicero was manager of marketing for re-entry systems with Raytheon Company.

The deaths of three of our classmates have recently been reported. **Frank J. O'Neil** of 26 Woodland Drive, Chesshire, Conn., died October 3, 1971. . . . **Lewis W. Crump** of 7907 Chelton Road, Bethesda, Md., died October 14, 1970 of an intracranial hemorrhage due to rupture of an aneurysm. Mr. Crump was an associate in the firm of Allen M. Voorhees and Associates where he made significant contributions in the field of urban data systems. He had received a B.S. degree from M.I.T., a master's degree in city planning from Yale University and a certificate from the Yale University Bureau of Highway Traffic. He was a registered Professional Engineer in Indiana, Ohio and Virginia, and had previously worked as a research engineer at M.I.T., with the firm of Alden E. Stilson & Associates of Columbus, Ohio, as a highway design engineer, and with the City of New Haven as a computer programmer. . . . **Joseph A. Sabo,** 63 Valley View Road, Fairfield, Conn., died February 6, 1972 in Arlington, Va. Mr. Sabo was an engineer for the Federal Aviation Administration in Arlington. He had previously been employed with the Sikorsky Aircraft Corporation in Stratford, Conn., where he was supervisor of the special projects section.—**Richard F. Lacey,** Assistant Class Secretary, 2340 Cowper Street, Palo Alto, Calif. 94301; **Arthur S. Turner,** Secretary, 175 Lowell Street, Carlisle, Mass. 01741

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Greetings. It's frost-on-the-pumpkin-time when you are reading this but at writing time the warm breezes are blowing over Gloucester harbor.

Received a card from **Mason King** during the summer. Mason received an M.T. from Harvard and is teaching mathematics at the Acton-Boxborough Junior High School where he is a teacher-coach. . . . **James J. Baker** is now vice president of Cullinane Corporation (which sells computer programs) and has six children. The oldest attends Browne and Nichols and hopes to attend M.I.T. when he graduates in 1974. . . . **Jerome Catz** became Associate Dean of the University of Miami's School of Engineering on July 1. . . . **Stephen Lirot** has been promoted to operations manager—specialty products at the Nestle Company's Manufacturing Division in White Plains, N.Y.

Martin Brilliant is running for the Township Committee on the Democratic ticket in "very Republican" Holmdel Township, N.J. He invites inquiries as to the outcome in November. . . . **Ko Muroga** presented a paper on electronic switching systems at the International Switching Symposium held at M.I.T. in June and enjoyed his visit to M.I.T. . . . **Jerry Perry**'s youngest daughter Dawn (4) is well on the way to a career as beauty queen with 71 trophies to her credit including three high-point trophies. Her latest: Huntsville's Little Miss La Petite 1971, Madison Counties Little Miss La Petite 1972 and Miss Dixie Majorette 1972.—**E. David Howes Jr.,** Box 66 Carlisle, Mass. 01741; **Charles Masison,** 76 Spellman Rd., Westwood, Mass. 02090

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It's always good to hear from classmates about their latest exploits, but if you're unwilling to write, why not have your spouse send a note with a summary of the happenings. Recently, I received a letter from Mimi Bowman, who wrote that she and her husband **Robert Bowman** enjoy living in "smog free" Santa Monica with their two daughters Leslie and Carol. Bob has recently been appointed Director of AVCO Corporation's Govern-

ment Products Group for the West Coast region.

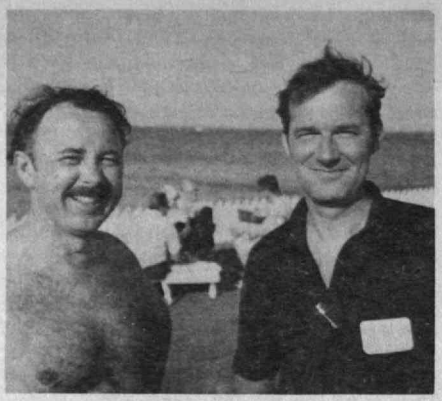
Philip N. Eisner has moved with his wife Betsy and son Ned to New Jersey. He is now working for Esso Research and Development Co. on pollution related research. . . . At the end of March of this year Captain **Philippe C. Gaucher** assumed the duties of Commanding Officer of the U.S. Coast Guard Base at Boston, Mass. . . . **Austin H. Somes** and his wife Susan have an addition to their family. A daughter Janet joins her three-year-old brother Daniel. Austin is working at the N.A.S.A. Ames Research Center, Moffett Field, Calif.

Hardware tests of the spacecraft engine control problems were performed at the Draper Lab in Cambridge during the flight of Apollo 16, using a duplicate guidance system in the Systems Test Lab. Among those working on the problem was **George P. Edmonds, Jr.** . . . **Paul H. Attridge,** who is president of Walter S. Attridge Co., was elected president of Highway Safety Associates. . . . **Robert C. K. Au** has been admitted to the partnership of Dames and Moore, the world's largest firm of consulting engineers specializing in applied earth and environmental sciences. Robert is a principal at the firm's Atlanta office. He has been responsible for multi-disciplinary environmental studies for nuclear power stations, dams and transmission lines. He is a registered professional engineer in 13 states and has worked for Dames and Moore previously in Honolulu and San Francisco.

An interesting story about **Roger Reiss** was covered in the *Boston Herald Traveler* last year. It concerned the jewelry and antique shop that Roger and his wife Judith opened in Newton. After being separated from G.E., he decorated the shop in Victorian style and began working there in earnest. Judith does the buying, and together they have developed a going concern. They have three children, Randel, Ronde, and Russel; and Roger has some critical views on the supply and demand for engineers and their consequent employment conditions.

At the May meeting of the M.I.T. Club of Fairfield County (Conn.) the after-dinner speaker was **Donald G. Brennan** of the Hudson Institute. He spoke on the topic "The United States and European Security." A frequent lecturer on national security subjects at universities and defense study centers, Dr. Brennan conducts technical research at the Hudson Institute, of which he was President from 1962 to 1964.

And now for some more nautical news. On Nantucket, **James Bartsch** and some friends have built a one-man submarine, mostly out of junk from the local dumps. The sub is yellow, with an orange conning tower, and is powered by a motor from a golf cart. Two of the tanks in the creation were filled with 2500 pounds of cement, but upon launching the thing would not submerge. The last I heard Jim was going to add 1000 pounds of lead and try again. I have no idea what happened. . . . Write me if your balloon flies, your boat floats or your horse wins.—**Allan C. Schell,** Secretary, 19 Wedgemere Ave., Winchester, Mass.



Members of the Class of 1957 at a beer party at the Provincetown reunion: top left: Jim Cunningham and Ron Keefe; top right: Harry Salesky, Alan May, and Dave Wolsk; bottom left: John Day, John Christian, and Andy Blackman.

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Roberto Perez Amador joined Sun Oil's new Puerto Rican refinery in 1971 and was named chief project engineer last May. Married in 1960 and father of twins, Roberto is now safely out of Cuba. . . . **Parvez Amin** writes from Pakistan that he became General Manager of R.C.D. Ball Bearings, Ltd. in the Korangi Industrial area of Karachi in 1970. His company is the country's only manufacturer of that product and is a joint venture of Pakistan, Iran and Turkey with technical collaboration with Japan. Parvez was married in 1960 and has three children.

Matt Barrett is providing consulting services to the Environmental Protection Agency for reviewing environmental impact of nuclear plants. . . . Major **John Frishett** received his Ph.D. in engineering at U.C.L.A. in 1971 and is now stationed at the Air Force Flight Dynamics Laboratory at Wright Patterson. . . . **Ralph Gaze** writes that he received a teaching certificate from the Royal Scottish Country Dance Society at St. Andrews, Fife. . . . **Tom Hoffman** is now in the Charlotte division office of Celanese Fibers in charge of training and development of plant supervisors. . . . **John Merkl** is manager of corporate planning and economics for the Latin American headquarters of Standard Oil of New Jersey (EXXON).

Jack Saloma has coauthored a book, *Parties: The Real Opportunity for Effective Citizen Politics* just published by Alfred Knopf. The book is the result of a three-year study of the political parties sponsored by the Twentieth Century Fund. . . . **Hank Valcour** started his own company, Mechanized Systems, Inc., In Marlboro, Mass., last year to make deionized water systems.—Cosecretaries: **Bruce B. Bredehoft,** 3 Knollwood Dr., Dover, Mass. 02030; **Mrs. Lloyd Gilson,** 35 Partridge Road, Lexington, Mass. 02173

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Reunion at Provincetown was a great success and a lot of credit goes to **Jim Cunningham** and his committee for their fine planning. In all there were 74 attendees for the weekend. Meeting old friends (now somewhat fatter and balder) was certainly wonderful but I believe that others there will agree that the making of new friends was equally rewarding. Here is the list of those who were on the scene: Betsy and Richard Baird, George Beerli, Andrew Blackman, Kathy and Lee Bredbenner, Karin and Paul Carr, Barbara and Julian Cherubini, Lynda and John Christian, Jo and Thomas Folkes, Jane and John Fredericks, Phyllis and Alan Godes, Martha Goodway, Jim Havender, Marilyn and Bob Heitman, Jill and Mal Jones, Sue and Hank Salzhauer, Isabel and Peter Sins, Marcia and John Tiller, Joyce and Alan Toomre, Barney Weinstein, Nancy and David Wolsk, Betty and Fred Morefield, Isabel and Jerry Collen, Anne and Jim Cunningham, Judy and John Currie, John Day, 3rd, Carolyn and Nelson Disco, Marguerite and Bill Doughty, Daly and Ronald Enstrom, Pat and Ron Keefe,

Barbara and Hugo Liepmann, Marilyn and Harry Margulius, Alan May, Virginia and Paul Nicholson, Louise and John Roberts, Don Roellke, Eleanor and Harry Salesky, Josephine and Bill Salmon, Carol and Carl Sandin, Ann and Gerald Saul, Jane and Michael Schneider, Janet and Howard Schumacher.

People started arriving Friday afternoon. Following an informal dinner everyone gathered around the indoor pool where a bar had been set up. Later on, the bold ones put on their swimming suits and took to the water. Saturday morning there were some ferocious sets of tennis (**Alan Toomre** has a vicious serve), bicycling into town and hiking along the dunes. Some were still arriving (Isabel and **Peter Sinz,** for instance, decided just at the last minute to come and caught a plane from San Juan) as the social activities went into full swing in the afternoon with a big beer party (see photos). The banquet in the evening featured some humorous speeches about Tech today from a trio who have remained there—**John Christian, John Currie** and **Mal Jones.** Prizes of great intrinsic mirth were awarded—to **Dick Baird.** the only classmate to have a son at Tech; to **Don Roellke,** the most eligible bachelor; to **Harry Salesky,** the happiest among the unemployed; to me, the one with the least hair; etc. The festivities continued with dancing and talking until the wee hours.

On Sunday morning dune buggy trips were arranged for the early risers. In the afternoon goodbyes were exchanged and everyone started home—**John Day** and **Alan May** had some of the longest trips—to California and Texas, respectively. That's all for reunion, 1973. The mailbag is full and I have a few inside stories picked up at the reunion—so, more in 30 days.—**Frederick L. Morefield,** Secretary, C/O Mobil Oil Caribe Inc., P.O. Box X, Caparra Heights Station, San Juan, Puerto Rico 00922

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Hope you had a good summer vacation this year and that you are already planning to take an extra vacation at our 15th reunion next June. Yes, it is our 15th reunion and if you are feeling older, just take comfort in the fact that most of the class entering M.I.T. this fall were born about the time you were a freshman at the Institute. If that doesn't help, then you will need to seek the assurance of other ancient astrologers in this "Year of the Reunion," all of whom, it is reliably reported, will be gathered at Harborside Inn on Martha's Vineyard from June 1-3.

Alan Storms has received his M.B.A. from Canisius College in Buffalo. Alan is currently a senior engineer in the product development section at Western Electric, Buffalo. . . . **Charles King** notes "am still located in Houston with Union Oil Co. of California as regional geophysicist. Mary-Jo and I have three children now." . . . **Donald Gall** was recently appointed Research Associate Professor of Surgery and Anesthesiology at the University of Pittsburgh School of Medicine. . . . **John Forrest** has taken on yet another assignment in Viet Nam. This time he has been assigned to the Advanced Research Projects Agency field unit in Saigon.

Paul Padget's Buckeye Auto Leasing firm in Cincinnati is prospering and Paul reports "we now have two of the Fortune 500 among our accounts and working hard on the other 498." . . . "The big news", Glyde and **Bill Cooper** announce, "is the arrival of our two sons, Bill and John, 21 months ago! Also we have moved from San Francisco to Berkeley—obviously we needed a little extra room(s). I am still at the Radiation Lab." . . . **Edmond Vinarub** writes "I am currently working with a new firm, Ocean Metrics, engaged in the development of range gated optical viewing devices. This equipment will be used for underwater television systems, fog and smoke penetrating equipment, etc."

Another note for investors arrived from **Mike Falk,** who is now president of Falk Fibers and Fabrics, manufacturers of nylon and polyester filament yarns and fabrics. . . . **Robert Rose** has been promoted to the rank of Associate Professor at M.I.T. in the Metallurgy and Materials Science Department. . . . **Jack Christensen** has been appointed Secretary of M.I.T. Development Foundation Inc. This organization will assist in the formation and growth of technology-based enterprises and spin-off companies. The Foundation will also sponsor research and engage in educational programs related to development of new enterprises. Prior to this post, Jack had been Director of the Industrial Liaison Office at M.I.T. He and his family, which now includes four children, live in Marshfield.—**Michael E. Brose,** Secretary, 30 Dartmouth Street, Boston, Mass. 02116

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Now that we've survived the summer, welcome back to another volume of 1959 Class Notes. During my summer vacation which took me through California, Colorado and Wyoming (lovely country!), I spent several days with Carmen and **Carl Neu** in their beautiful home in Denver. Carl has been bitten by the entrepreneurial bug and is a co-principal in a new firm, Xicom Rocky Mountain, Inc., involved in management training. Among their first clients is the Denver Police Department! We were joined in Denver for dinner one evening by Barbara and **Ron Stone** who were embarking on a three-week camping trip through the West. During their travels through eight states and ten national parks, they managed to spend an evening camping with **Dick Hall** and his family at Beverly Beach, Ore. Dick is a group leader at Aerospace Corporation and is living in Torrance, Calif., with his wife Landa and their two sons (Rikki, 7, and Jeff, 5).

We recently received word that one of our more illustrious classmates, **Walt Humann** was elected corporate vice president—commercial group for the L.T.V. Aerospace Corporation, Dallas, Texas. He will resign as the company's vice president, secretary and general counsel. Walt's recent civic activities include membership in the "Goals for Dallas" Task Force on Education, chairman of the advisory board for the skyline Center for Career Development in Dallas, and membership on the communication's committee of the National Chamber of Commerce.

Hank Couch writes that he has been elected vice president of the Morley Machinery Corporation, Rochester, N.Y., and of its production division. He's been with Morley for thirteen years. Morley is one of Rochester's largest machine job shops specializing in precision metal cutting. . . . On the literary scene, **Norm Miller** is entering his third year as the humor editor for Rust Craft Greeting Cards in Dedham, Mass. . . . **Myer Kutz** is putting the finishing touches on his 200,000-word epic whose preliminary title is *Rockefeller Power.* . . . **David Pawliger** is currently Assistant Professor of Medicine at the University of Florida, specializing in hematology and oncology. . . . Class Treasurer, **Chuck Staples** is vice president of Call-A-Computer and is responsible for finance, administration and operations.

Marty King writes that he is just completing his two-year tour with the Air Force at Lackland Air Force Base. He is now a board-certified pathologist and with his wife Flora and two sons (David, 3 and Anthony, 4 months) will be moving to Corpus Christi, Texas to enter private practice. . . . **Dick Swenson** writes that he was married on June 8, 1972 to the former Ms. (*sic*) Linda Marcia Marber a 1971 graduate of George Washington University. Dick graduated cum laude from Harvard Law School, took the New York Bar Exam in July, honeymooned in August and will begin work this fall at the Park Avenue Law firm of Kaye, Scholer, Fierman, Hays and Handler. . . .

Lydia and **Bob McAuliffe** with their three offspring spent the month of June in the Netherlands with Lydia's parents. Bob, in addition to his position as vice president—operations for Landtect Corp. in Philadelphia, is also a partner in Beckett Associates, a new-town venture in Gloucester, N.J. His current major hobby is flying. Bob owns a Cessna and is building time toward his commercial pilot rating.

Ed Cheatam writes that he is back at Sperry Rand in corporate communications, after a two-year stint with a small consulting company. He has been travelling a lot, but is now pretty well entrenched with wife and three kids in Smithtown, Long Island. . . . **Jerry Glass** is presently with the Radar Systems Laboratory at Raytheon in Wayland, Mass. . . . **Charles Hill** informs us that he was promoted to Associate Professor of Chemical Engineering at the University of Wisconsin. He's been working with members of the Food Science Department on applications of membrane separation techniques in the food industry. This past year, he received the Polygon award as the Outstanding Instructor in the Department of Chemical Engineering for the second time in the past three years. . . . **George Kraft** announced the birth of a son, Michael Scott last May 6. George is still with the Bell Laboratories Electronic

Switching Division in Naperville, Ill.

Well, that's about all the news I have 'til now. I'll be back next month with more timely tales and tidbits.—**Arthur J. Collias,** Secretary, 61 Highland Rd., Brookline, Mass. 52146

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This will be my first attempt to fulfill the obligations of a "Regional Vice President", so please bear with me. Actually, the collection of news items and data which arrived included inputs from all over the world, so I'm confused by my "Regional" title.

Since I'm assisting Class Secretary **Linda Sprague** in assembling this column, I'll start with a brief note that she and **Chris** are moving to California for a year beginning this summer. . . . **Dan Chin** called me a while ago during the Alumni Fund's marathon telephone fund drive. He is doing consulting work for a firm in the Boston area, but I failed to record the name of his organization. . . . **Bob Keeney** writes that he is now Manager of Market Administration in General Electric's Low Voltage Switchgear Department (Philadelphia). He adds that he and his wife Marge spent a day last year with **Craig Sawyer** (Course X) and his wife Lori. The Sawyers have since moved to Los Angeles. . . . Corning Glass Works announced in January that **Raymond R. Ambrogi** has been appointed Manager of Bio Medical Packaging Systems. Prior to this appointment he was Manager of Corning's North Bergen, N.J., plant. . . . **David H. Geisler** was transferred to Richmond, Va., by DuPont to work with Industrial Nylon in the Textile Fibers Department.

Moving on to notes from the European branch of the "Midwestern Region", we hear that Captain **Doug Nelson** is enjoying his assignment in Germany. . . . **D. B. Kellermann** writes that he is in charge of Chemicals Economic Evaluation for Dow Chemical Europe S.A. in Zurich, Switzerland. He married a Dutch citizen, and they have two children: Anastasia (3) and Lawrence (6 months). . . . Also in Switzerland, **Howard Hornfeld** writes that "Swiss industry is surprisingly successful commercially, but no one knows how!" He is working for Battelle Institute in Geneva. . . . Major **Roger D. Hohman** writes that he is now Executive Officer for the 249th Engineer Battalion in Karlsrune, Germany. The 249th Engineer Battalion is a construction unit with over 35 million dollars in equipment. . . . In a final note from Europe, Dr. **E. Gerald Hurst** states that he will be in Brussels, Belgium for a year.

Moving back to our Midwest Region, we find that **Raymond Laub,** President of The Laub Group, Inc., has been elected President of the Metropolitan Milwaukee Independent Insurance Agents Association. His firm has offices in Milwaukee, Janesville, and Wausau, Wis. . . . **Charles E. McCallum** of Grand Rapids has also been honored by elective post. He is now a member of the Council of The National Municipal League as well as a director of the Greater Grand Rapids Chamber of Commerce. His second daughter, Kyle, was born in March on his birthday. . . . **Lawrence R. Kravitz** writes that upon his return from Vietnam he was assigned to Warren, Mich., to work on the Army's Main Battle Tank program. . . . **Sheldon Epstein** is now a member of the Law Dept. at Brunswick Corporation in Skokie, Ill. His brother-in-law, **Sam Latt,** is now an Assistant Professor at Harvard Medical School and lives in Newton, Mass. . . . **Robert Gottlieb** receives his Ph.D. from the University of Texas by September. He'll take a position as Vice President of Lewis Industries in Kansas City, Mo.

My own situation is that of having just completed my first year as President of RADMAR, Inc. which I founded after several years of preparation which included the Alumni Association's Entrepreneurship Workshop. RADMAR, Inc. manufactures audio-visual equipment (primarily low-cost Filmstrip Making Products), designs and installs surveillance and security systems, and consults on marketing and technical aspects of new products and businesses. This first year has been a fantastic experience, but next year we hope to improve our lot and become profitable too.—**Richard M. Davidson,** Midwest Regional Vice President, 2100 Techny Rd., Northbrook, Ill. 60062

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The trends for our classmates appears to be to go foreign. . . . A move is in the near future for **Charles C. Gerheim.** He is going to Algeria on a two-year contract to provide technical assistance to refining operations on Sonatrach, an Algerian national oil company. He is looking forward to excitement and challenge in his new assignment. . . . Captain **Niel K. Weatherbie** has been assigned as Commander, 1995 Communications Squadron, Air Force Communications Service, Eielson A.F.B., Alaska. . . . **Xavier L. Simon** has recently been named manager of convenience products of Anderson Clayton and Company, S.A. Acco Products Division, Mexico. . . . Lieutenant **N. Deon Free** has just completed four years at Naval Postgraduate School in Monterey, Calif. He received an M.S. in operational research in September, 1970. He spent the last two years teaching OR and working towards his Ph.D. in this field. He hopes to complete this in the future after upcoming two-year tour at the Naval Supply Depot in Subic Bay, the Philippines. His wife, Marlene is a professional home economist and they have a five-year-old son, Daren. . . . 1971 and 1972 are also turning out to be international years for **Raymond P. Wenig** and his family. Business commitments include Germany, Australia, Belgium, and Canada. The Wenigs spend their spare time traveling and camping in their motorhome "The Turtlebox".

Judith Selvidge just finished doctorate work at Harvard Business School. She will be teaching at the University of Colorado. . . . Congratulations go out to **Frank Nubin** for receiving his Ph.D. in Systems and Information Science from Syracuse University. This was possible by an IBM Resident Study Grant. . . . **David C. Corson** has been named western district sales manager of Enjay Chemical Company's Paramins Department. They have offices in Houston, Tulsa, San Francisco. David will remain in Houston. . . . **Robert E. Dickinson** is the research meteorologist at the National Center for Atmospheric Research in Boulder, Colo. He received the N.C.A.R. Outstanding Publication Award for 1971. His paper "Analytical Model for Zonal Winds in the Tropics" appeared in the June issue (Volume 99, #6) of the *Monthly Weather Review*. . . . **David R. Spencer** and his wife, Pam, have purchased a home in Lexington, Massachusetts for their son, Marc. They will all live together in his new home as one big happy family. David is continuing as manager of graphics engineering at EG and G in Bedford, Mass.—**Gerald L. Katell,** Secretary, 122 North Maple Dr., Beverly Hills, Calif.

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This issue of the *Review* brings forth three Class Heroes, all of whom made a special effort to keep me informed of their activities. **Len Parsons,** Associate Professor of Marketing at Claremont Graduate School, informed me that he was named first prize winner (worth one grand) in the American Marketing Association's Research Design Competition. His topic was "The Hierarchy of Effects Controversy; A Research Design." . . . **Bill Roberts,** his wife Linda, and their year-old son Will spent the summer of 1971 at M.I.T., where Bill was a visiting scientist on leave from the University of Virginia. This past summer Bill and his family were at the State University of New York at Stony Brook. Bill reports that the past two summers have been especially enjoyable because of the opportunity to renew old friendships with classmates. . . . **Al Teich** and his wife Carolyn are the proud parents of their second son, Kenneth, born on the fourth of July. Al has edited a collection of readings, *Technology And Man's Future,* published by St. Martin's Press in April of this year. He reports that he is a research fellow with the Policy Institute of the Syracuse University Research Corporation.

As for news of others . . . **Mark Ain** is with Billings and Reice, a ten-man management consulting group based in Concord with an international clientele. . . . **Robert Beardsley** has been promoted to associate professor at M.I.T. in the Department of Meteorology. . . . **John Boorn** has joined the Rouse Company as a development director, working with a team developing the downtown section of the new city of Columbia, Md. . . . **Frank Carpenter** received his Doctor of Ministry from Meadville Theological School in 1970, and since that time has been minister of the First Unitarian Church of Chicago, located on the campus of the University of Chicago. . . . Two classmates, **Philip Chapman** and **Anthony England,** have left N.A.S.A. as scientist-astronauts to assume other positions. Chapman has taken a research job with Avco Everett Research Laboratory and

will also be a senior research associate at M.I.T. England is working with the U.S. Geological Survey's Geophysics Group in Denver. . . . **Bruce Crocker** received his M.B.A. from Stanford University this spring and is now working for Envirotech in Menlo Park, Calif. . . . **Joe Domine** is working for Union Carbide as a project scientist. He and his wife Caroline moved into their new home last fall. . . . **Ronald Frashure** has been promoted to assistant vice president of the Putnam Management Company, which manages the Putnam mutual funds. Ron was a Sloan Scholar at M.I.T. and a Baker Scholar at Harvard. . . . **Jon Gruber** is a partner in the investment banking firm of Robertson, Colman and Siebel in San Francisco, where he is enjoying the California living.

John Huguenin is a research associate at Woods Hole Oceanographic Institute, where he designed a unique aquatic pollution control laboratory facility. . . . **Bruce Knobe** will be teaching at the Hebrew University in Jerusalem for two years beginning this October. . . . **Margaret MacVicar,** Assistant Professor of Physics at M.I.T., has been elected one of four new trustees of the Carnegie Foundation for the Advancement of Teaching. The Foundation provides pensions for retired college teachers and conducts studies in the field of education. . . . **Doug McCallum** is still living and working in Scotland. He and his wife are the parents of a son born in December of 1971. . . . **Pete Ordeshook** is an associate professor at Carnegie-Mellon University. The Ordeshooks became parents of a girl born in August of 1971. . . . **Bill Rentz** is Assistant Professor of Finance at the University of Texas. He and his wife Carol were married in 1970, following a courtship which began in the parking lot at Northwestern University in 1968 when gallant Bill came to her aid to start a balky Volkswagen (no wonder it's called the Love Bug!). Bill received his Ph.D. in economics in 1971 from the University of Rochester. Carol is now working on her Ph.D. in philosophy. . . . **Robert Popadic** has been promoted to vice president in the administration and control department of the computer services division of the State Street Bank and Trust Company. . . . That's it for now. Let me hear from you.—**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

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With a long delay since the last *Review,* the mailbag has had a bit of a chance to fill up. So we're back to the days of longer columns. Two people even sent real live letters! **Chico Gholz** reports that he ran into **Dave Cook** at the M.I.T. Club of Baltimore Alumni Fund telethon last May. Dave is now fulfilling his military obligation as a doctor at the Public Health Service hospital in Baltimore. Chico says that Dave "never has to wear his uniform" and doesn't seem to be suffering visibly from his contact with the military. Chico is still active as treasurer of the M.I.T. Club of Baltimore for 1972-73 and had an article published in the March issue of the *George Washington Law Review.* . . . This month's other letter was from **Alan Schutz** who reports that his older son Christopher is 3½ years old and about to start nursery school. A second son, Jeremy, was born May 28 and the Schutzes also have recently taken in a 17-year-old foster daughter. Alan is quite busy as director of engineering for Frequency Devices, Incorporated of Haverhill, Mass. Alan sent along some brochures and *Electronics* articles quoting his comments on Frequency Devices' new modular-type filters.

The Next Generation

Several notes reported the birth of new youngsters to some of our classmates. **Jerry Robertson** reports a second son, Thomas, born May 13, in Concord, N.H. Jerry is still in engineering with Northeast Electronics of Concord. . . . **Bruce Appleby** reports a daughter Deborah Elizabeth was born on May 31. Son Stephen Michael is just completing advanced kindergarten and Bruce is a systems programmer at Western Electric in No. Andover, Mass. . . . Ronnye and **Gil Falk** are the proud parents of a daughter, Felicia Rebecca, born March 11. Gil is still on the computer science faculty at Rutgers University in New Brunswick. . . . **Dave Cook** sent his own note (in addition to Chico's letter) telling of the birth of daughter Rebecca Eve on April 27. Dave will finish his tour as a lieutenant commander in the Public Health Service next July, then plans to return to Denver and his residency in medicine.

This Generation

Dave Carrier writes that he is still with N.A.S.A. after three years—longer than he ever intended. Dave says it's amazing how time flies when you're having fun. For Dave, fun has been working on lunar soil mechanics for the Apollo program and playing with three-year-old daughter Bettina. The Carriers go to the beach at Galveston every summer weekend, but say its not the most spectacular beach they've seen. . . . **Ron Wilensky** is now employed as senior physicist by Technology for Communications International of Mountain View, Calif. . . . **Dave Hall** is at the Naval Electronics Lab now. He received his Ph.D. in electrical engineering from CalTech. . . . **John Holdren** is now at CalTech as a senior research fellow on a year's leave from the controlled program at Livermore. John's appointment is a joint one with the CalTech Population Program and the Environmental Quality Laboratory. John coauthored (with Phil Herrera) a Sierra Club book entitled *Energy* that was published in February.

Charles Lozar is working in the U.S. Army Construction Engineering Research Laboratory in Champaign, Ill. He is involved in an architectural research program to evaluate behavioral response to environment and provide new criteria for design of army facilities. The work involves timelapse photography, setting analysis, and survey techniques. . . . **Roger Wright** is at the Westinghouse Research Laboratories in Pittsburgh figuring out better ways to make wires and filaments. . . . **Bob Morgan** has joined the corporate advertising department of American Chain and Cable Company (Acco) as editor. He is responsible for *Accomation,* a company publication, and for various public relations activities. . . . **Bob Reichelt** was transferred by Humble Oil and Refining Company from Houston to the Baltimore area. He is still in employee relations and was promoted to employee relations coordinator, compensation and personnel development.

Po-chiu Mar has left data processing after seven years and joined A.M.F., Inc. as a corporate business planner. Bliss is gaining an additional two hours of one's life from no longer having to commute into New York City. . . . **Dick Bator** has joined IMLAC Corporation of Needham, Mass., as software systems manager. Dick will be responsible for software development and customer services in connection with IMLAC's PDS-1 minicomputer. He was formerly vice president of Azrex, Inc. of Burlington, Mass. . . . **John Chiapetta** is a project engineer with Hudson Engineering in Houston, a firm specializing in natural gas processing. He and his wife Carol are raising two gerbils. . . . **Dick Larson** has been promoted to Associate Professor in M.I.T.'s Department of Urban Studies and Planning.

Second and Third Degrees

It doesn't look like we'll ever all get out of graduate school. **Peter Norris** will return to M.I.T. this fall to begin work on a Ph.D. in electrical engineering. Pete will hold a David Sarnoff Fellowship from R.C.A. He has been working at R.C.A.'s Process and Applied Materials Research Laboratory in Princeton, N.J. Pete and his wife Fern have a three-year-old daughter, Rebecca Jan. . . . **Leland Neuberg** is at Berkeley working for an M.C.P. and Ph.D in city and regional planning. He received an M.S. in math from Northwestern in 1966 and an M.S. in physics from the University of Illinois (Chicago Circle) in 1971. He was with SDS from 1965 to 1967 and an instructor in mathematics at Chicago City College from 1967 to 1968. Leland reports the birth of a daughter Eva Simone last January. . . . **Burt Lowry** was a navy aviator for five years after graduation and is now at the University of Chicago. He was recently awarded an N.S.F. Fellowship for the next three years' work at Chicago in bio-physics and neuro-science.

The doctors are also active. **Bill Brody** is a resident in cardiovascular surgery at Stanford Medical Center. He has been working on applications of ultrasonic measurement techniques to open heart surgery and developing experimental techniques for coronary artery surgery. Bill and Wendy are looking forward to a move east in 1973 when Bill will join N.I.H. in Bethesda for two years. . . . **Martin Goldsmith** is in his third year of residency at the New England Medical Center Hospital. His son Michael is two years old. Martin hopes to enter practice in Massachusetts following completion of his residency in June of 1973. He says his main pastime is golf.

To Colorado

And so, having finished October's column

(in August) your secretary fades into the west for a two-week climbing vacation in the Rockies. Happy autumn, all.—**Steve Lipner,** Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

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Here is a report on our reunion that was held at M.I.T. in June. **Stan Rose** and **John Rudy** sent letters describing the event: 66 classmates attended, and the reunion was a great success. Almost half of the people stayed in remodeled Burton House. On Friday night there was a lovely reception hosted by President and Mrs. Wiesner and Dr. and Mrs. Gray. A party followed at Burton. The weather cooperated for a Saturday afternoon clambake on Briggs Field. That night there was a party in the Student Center. The reunion was held on campus to reduce costs, and this probably boosted the attendance figure.

At the clambake, class officers were elected for the next five years: **Gary Garmon,** President; **Jeff Wiesen,** Vice President; **John Rudy,** Class Agent; and **Jim Swanson,** Secretary. The Executive Committee consists of Mike Daily, Al Hayes, John Howard, Bill Dix, Joe Ferrara, Bill Hsu, Chuck Kolb, Dave Kress, Joe Levangie, Frank March, Stan Rose, John Ross, and Mike Telson. Stan Rose did an excellent job in running the reunion; thanks go to him and his committee: Bill Dix, Mike Daily, Gary Garmon, Chuck Kolb, John Ross, John Rudy and Jeff Wiesen.

After nine years at M.I.T., Barbara and **Bruce Williams** have moved to Houston. Bruce received his Ph.D. in math in June and is planning to teach at Rice University. Barbara will study for her Ph.D. in sociology at Rice; 18 month-old Eric is enjoying the southern climate. Barbara and Bruce reported on some friends they met at the reunion: **Don Bellenger** is about to leave the navy after spending three years in Newport as an officer; **John Robison** picked up his M.B.A. at Boston University and is working for a medical instrumentation company on Route 128; **Ron Olsen** is working for Bell Labs in N.J.

Elaine and **Joel Shwimer** are in Paris for a year. After nine years at M.I.T., Joel received his Ph.D. from Sloan. They have moved to Paris in order to help Elaine in her Harvard doctoral research on the novels of Alfred de Vigny. Joel is an Ingénieur Conseil for the Société Nationale des Pétroles d'Aquitaine. They would like to hear from any classmates in Paris. . . . **George Starkschall** has left Harvard with a Ph.D. in chemistry-physics. . . **Howard Greenbaum** left Raytheon to join Bell Labs in N.J. as a business systems specialist. He has been doing a little traveling. . . . **Bob Karz** has completed work on his Ph.D. in metallurgy from the University of Illinois at Urbana. He is an associate scientist with Xerox in Rochester, N.Y. Bob is looking forward to leaving the cornfields and returning to the hills, lakes, and trees back East. His wife Myrna plans to learn how to ski.

Ted Nygreen has given me the lowdown on his activities over the last five years. He worked at R.C.A. Labs for four years while getting his Ph.D. in sociology from Princeton. Ted writes that he "liked the area so much that we bought a house and decided to stay there ("we" being Nancy and our 1.5-year-old daughter Kristin). After my academic stint, I started working for N.B.C. in the Big Apple, and now I am one of the many daily commuters to New York City from sunny New Jersey. All things considered, I love it on the east coast and plan to stay a while. I guess that is my history in short. Although I started toward an academic career in sociology, I ended up in the business world. . . . Incidentally, last summer at the annual meetings of the American Sociological Association in Denver I ran into an old friend (enemy?) named **Georgio Piccagli,** who, as you probably know, is a graduate student in sociology at Chicago. Perhaps M.I.T. is tending towards a more liberal arts/social science orientation, and we are the leaders of a movement toward sociology."

A note from **David Berrian**: "This is the first time I've communicated to you since graduation. Much has happened; I will relate to you some of the milestones. I dropped out of M.I.T. graduate school in oceanography in 1968. Having made a firm personal commitment to end my support of the War in Vietnam and militarism in general, I looked for C.O. alternative service. During this time I married one of the world's most beautiful women, Phoebe Winterbottom. In 1969 I moved to Washington State, went to school at Seattle Pacific College to get my teaching credentials, and taught science and math in a public school on the Makah Indian Reservation at Neah Bay. The teaching experience was very frustrating, rewarding, and tempestuous. At the end of 1970 I moved to Bellingham, Wash., where I remained virtually unemployed for over a year. During this time I did some manual labor, spent time with a free school, and worked with a welfare rights organization. I now work as a janitor and bus driver for Bellingham Head Start. Slowly I am growing as a person and developing alternative ways of living."

In August, 1971, **Joseph Levangie** married Pamela Kurtz. Joe is working at Sperry Rand, experiencing fun and frustration in starting new business ventures. They live in Watertown; friends should get in touch. . . . **Carl Hewitt** has finally graduated and is now a member of the Artificial Intelligence Laboratory and an assistant professor of electrical engineering. Old tools never die, they just. . . . Linda and **Markus Zahn** have their second child Daniel Jacob, born February 5, 1972. They spent the summer in Washington, D.C. . . . **David McMillan** has been with MITRE since 1970. He has been pursuing the currently hot topic of aircraft collision avoidance. David and Marilyn and their two children Dwight and Courtenay Ruth live in Tewksbury, Mass. David has also been teaching a graduate course in linear programming at Northeastern. . . . **Steve Marcus** has just joined the law firm of Greenberg, Bernhard, Weiss, and Karma. He is practicing general business law and business litigation. An Army Reserve commitment prevented his attendance at the reunion.

Here's an interesting letter from **Eddy Shalom:** "Perhaps you can't remember me at all; I've neglected my M.I.T. connections, and this is the first posting of my 'condition.' I remember taking a judo class together, and that you demonstrated a good deal more fortitude in the sitting up exercises. After an abortive stay in Brown University's graduate school, I filtered back home to Brooklyn for several months, then back to good old Cambridge to work as a cab driver and evade the draft. These draft problems took me to San Francisco and Berkeley where I also experienced and survived the cultural transformations and metamorphosis of values and all the other bullshit. Worked in door-to-door-sales, grease monkey in a tool-and-die company. I then left for the East after almost two years for family-related causes. I worked in a Manhattan bookstore for a year, also hacking a little too till a truck side-swiped me—I'm through with cabs! Just spent six weeks in Mexico and Guatemala, poor but richly tanned. Now I'm not sure of my personal direction, but I am sure that in time I will find a niche that will make use of my energies and, dare I say it, my intelligence. Am a lover of mountains and the Grateful Dead, while practicing amateur water coloring. I hope the rest of the M.I.T. class of 1967 are all just fine!"—**Jim Swanson,** 508 Thompson Ave., Mountain View, Calif. 94040

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How strange it is to be starting the fall away from Cambridge for the first time In eight years. Believe it or not our fifth reunion will be coming up this June. More details on this when they are available. Meanwhile, on with the news.

June Graduates

Jeff Tanen reports that **Ken Rosenberg** graduated from Penn. Law School and that **Ric Klass** and **Gary Anderson** graduated from Harvard Business School. Jeff is working for the New England Electric System and lives in Westboro, Mass. . . . **Al Singer** and **Steve Straus** received M.D.s from Columbia. Al will stay at Presbyterian Hospital for his internship while Steve is going to be at Barnes Hospital in St. Louis. . . . **Paul Kimball** received a Ph.D. in molecular biology from Berkeley and is now an instructor in the University of Illinois Medical Center in Chicago doing research with RNA tumor viruses. He adds, "Cancer is the big thing these days!" . . . **Tom Romer** completed graduate work at Yale and has moved back to Canada after an eight-year absence. He is teaching economics at the University of Western Ontario. . . . Both **Paul Gluck** and his wife Joan (Penn '68) graduated from New York University School of Medicine and are taking their internships at Jackson Memorial Hospital in Miami. Paul is in obstetrics-gynecology and medicine while Joan is in pediatrics. They write, "We are currently booking reservations for anyone willing to 'come down' to visit during the winter." . . . In a similar vein

Chris Davis reports that he graduated from the George Washington School of Medicine and his enthusiasm was so contagious that his wife is now taking premed courses and plans to enter medical school next year. . . . **Aviva Brecher** received her Ph.D. in applied physics from the University of California at San Diego where she worked with Professors Alfven and Arrhenius. She has returned to old Cambridge and is now a postdoc in earth and planetary sciences at the 'tute. . . . **Joel Tepper** graduated from the Washington University School of Medicine and is now an intern in medicine at Presbyterian-St. Luke's Hospital in Chicago. . . . **Timothy L. Johnson** has been appointed Assistant Professor of Electrical Engineering at the Institute, beginning Fall 1972.

Military Musings

It is a good sign of the times that this is relatively small, especially with respect to the previous section. Unfortunately this was not true when we first graduated. From our good friends at the U.S.A.F. Home Town News Center at Tinker A.F.B. comes news that First Lieutenant **Gordon Logan** has been temporarily deployed to Mildenhall R.A.F. Station, England from Dyess A.F.B., Texas. Gordon is a C-130 pilot with the 348th Tactical Airlift Squadron. . . . Also from Tinker comes word that **Bob MacDonald** has graduated from A.F.O.T.S. and is now training to be a navigator at Mather A.F.B., Calif. . . . From Florida **Craig Pynn** writes that he is now in the Navy as Officer in Charge of Construction Battalion Unit 410 in Jacksonville. This is a 45-man seabee construction force engaged in general construction projects at Navy bases in Northern Florida and Southern Georgia. He finds that, "General contracting is an eye opening experience for an electrical engineer used to the relative calm of the lab." . . . **Richard Scott** is stationed at an Air Force communications detachment at Camp Zama, Japan, about 45 minutes from Tokyo by train. He reports that in addition to his regular work of expediting telephone and data communications, he is making progress learning Japanese and greatly enjoys the local architecture, flora, and fauna. A happy return to civilian life is expected in November 1973.

Here and There

William Steves reports that he is a president of the Anderson Mattress Company which he purchased from his family recently. He has been in the company since June 1968, shortly after his father, the previous president, was killed in an airplane crash. Last year's sales and profits reached a new high and this year both are up 20 per cent. The company employs about 90 persons and sales are expected to exceed $3,000,000 this year. He adds that he is still single. . . . **Richard Plotnick** and his wife Roberta are building a new home in Cherry Hill, N.J. . . . Not far away in Trenton, N.J., **Steve Osheroff** is working for the Department of Higher Education. He has had dinner several times with Jimmy Joe Jackson, '70, at nearby McGuire A.F.B. Steve plans to move to the D.C. area in the near future. . . . **Richard Tinkelman** reports the birth of a son, Joshua Aaron, on October 2, 1971. . . . Several items of domestic news from the Boston area. **Richard Goetz** is now working at MITRE/Bedford and writes that he and Claire are living in a new house in Lexington with their three children Susan, Ricky and Christopher. . . . **Charlie Thomas** is planning director for the Town of Wellesley. He has two girls, Michelle, 3, and Kristin, 1. He thinks he is one of the first in the class with two kids as Kris was born on June 16, 1972. I suggest he call up Richard Goetz and discuss the issue. . . . **Ray Paret** has moved to Weston and reports that his studio is doing fine. . . . Finally one piece of mail this month from an exotic place—Aruba. **Walt Eldredge** is there on a two-year assignment with Lago Oil, on loan from Humble Oil. He writes, "Never rains, always about 80°F, great for sailing and diving". His address is Box 1004, Seroe Colorado, Aruba. . . . That's all there is this month. As we are starting a new year we'll remind you that the only way we get news is from people writing. So if you enjoy reading this, drop us a line about what you're doing. If you don't think that's interesting, tell us about the weather. See you next month.—**Gail** and **Mike Marcus,** Class Secretaries, 2207 Reddfield Dr., Falls Church, Va. 22043

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Greetings readers—the column has been graced with many notes and letters. Leadoff honors fall upon **Robert Schmidt** who married the former Justine Flesher, an elementary education major from Glassboro State College in New Jersey, in June. The honeymoon was in Nova Scotia followed by taking up residency in an apartment in Blackwood, N.J. Robert states that "nothing overly exciting really" was happening. . . . Marc Kahagan, '71, is engaged in many interesting activities, including studying music and acupuncture "in preparation for a career in healing and joy giving." However, before entering medical school this fall, he plans to finish writing a book on film for children of all ages. . . . The stork is in direct flight for the **Joseph Diliberto** home, but word has it that the bird is in a holding pattern until Labor Day. Welcome Joseph or Christina.

Received a nice letter from **Rick Walleigh** telling us that he has left his job with Boston Edison to take a three-month cross-country vacation with his wife Wendy via a VW camper. However, September will find them back in the Hub with Rick starting Harvard Business School. . . . **Wayne Porter** is spending his entire third year at Duke University Medical School doing special research in virology. . . . **William Copeley** writes that he is finally getting out of "Lowville" and heading straight for beautiful Wyoming and graduate school in American studies. . . . Neurochemistry research in hepatic coma is an activity that is occupying the summer before **Ronald Polinsky**'s third year at Dartmouth Medical School. . . . Pratt and Whitney laid off **Oscar Asbell, Jr.,** but he was quickly employed by Kollmorgen in Northampton, Mass., to be a design-analytical mechanical engineer. His wife Kathi is head dietician at the Franklin County Public Hospital. They moved into their new house in July and have been doing a little canoeing and camping.

Geoffrey Handler married the former Judy Bernstein of Yonkers, N.Y., and is presently attending the University of Chicago Law School. . . . A master's degree in operations research was received by **Harold Wilkensky** immediately preceding his employment as a systems analyst for Lulejian and Associates of Arlington, Va. . . . Short note—**Jonathan Salmon** obtained his S.M. from M.I.T. . . . **Paul Lawson** married Annette Tarnapoll (Brandeis) in February at the M.I.T. Chapel with a reception following at Anthony's Pier 4. The couple honeymooned in Paris and Switzerland. Paul writes that while he is working happily for Esso Research on photovoltaic solar energy conversion and attending Rutgers part time for a master's degree, Annette will be going to N.Y.U. Law School. . . . Don't go away—another N.Y.U. student, **Robert Seymour, Jr.,** is taking graduate courses in physics while working for the Philips Laboratories Division of North American Philips Corp. Robert married Polly Hutcheson (Wellesley '71) in June. . . . **George Biehl** is still teaching high school science. Also in his plans are some graduate school courses in Philadelphia and a month of climbing in Wind River Range, Wyoming.

Timothy Heyman continues to enjoy himself in the international corporate finance division of N. M. Rothschild and Sons Ltd. . . . **Michael Safonov** has completed Naval O.C.S. and will be an electronics and materials officer aboard the aircraft carrier U.S.S. *Franklin D. Roosevelt*. . . . The information resources of the *Technology Review* are very extensive, Tom. Non-commissioned officer **Thomas Hafer** wonders how we know so much about him. . . . **Luther Tai** is pursuing a doctorate at N.Y.U. (that's three) after having been awarded an M.S. in chemical engineering. He spent June in Europe and has been working for Consolidated Edison for several years. . . . The former Susie Van Buren (Jackson '72) accepted the marriage vows of **Mark Phelps** at a wedding in Illinois last September. Now the couple lives in the Greater (?) Chicago area while Mark attends Northwestern University Law School. . . . Short note: **Charles Breverman** is working at the Stanford Medical Center.

Here are some noteworthy tidbits: **Lim-Ming Chui,** who is working as a computer systems engineer in N. Billerica, Mass., was a member of the 1972 United States Men's Table Tennis team which played against the Chinese team recently. . . . **James Pelegano** recently associated with the N.Y. Hospital-Cornell Medical Center was married to the former Miss Janice Quinn in White Plains, N.Y. They are making their home in Milan, Italy, where James is attending medical school at the University of Milan. . . . Private **Charles Movit** is an expert in field missiles maintenance and use. He had received an M.A. from University of Pennsylvania. . . . We got a nice wedding

picture of **Timothy Gilmore** and the former Susan Murphy (University of Washington); the ceremony was held in Cheney, Wash. Timothy was awarded an M.S. degree in environmental engineering from M.I.T. and is now co-director of the Environmental Pollution Authority in Juneau, Alaska. That reminds us, any extra photographs showing your activities are welcome—maybe even some of them could get printed in the column. . . . **Philip Bobko** received a degree in educational research from Bucknell. . . . **Edward Clendenin, Jr.,** is attending the graduate school of business at Washington University in St. Louis. . . . The University of Illinois will be the site of further studies in organic chemistry of **Tyler Thompson** who was fortunate enough to receive a substantial N.S.F. grant.

G. J. (Willie) **Vicens,** former coxswain for M.I.T. crews, has published an article in the *Journal of the Boston Society of Civil Engineers* concerning development of the Boston Harbor and related coastal engineering. An interesting work and probably very satisfying to Willie to see it in print. . . . **Gordon Tyler, Jr.,** was married in June to Mary Altalo (Smith) of Bloomfield Hills, Mich.

A tip of the hat to **Edward Markowitz** for a very informative letter, much of which follows: **Earl Woltz** is a graduate student in Course X and concentrating on finishing his thesis. Also, he spends some relaxing hours working out at the boathouse. **William "Jeff" Franks** who had married Bonnie Shapiro (Simmons '70) is working for Inforex in Burlington, Mass. . . . **Joe Bisaccio** has continued his business successes after graduating from the Harvard Business School by opening Bruxuge pinball arcade near Northeastern. Ed has revealed a rumor that **Keith Collins** is teaching five-year-olds in a day care center in Worcester. At last a long awaited tidbit about **Ed Chalfie,** the Chicago heavy-equipment operator and garnished main course extraordinaire, revealing that he may be working for an airline in London. **Jeff Gale** is studying for a Ph.D. in management at U.C.L.A. **Jay Zager** is gainfully employed by Xerox in Rochester, N.Y. . . . **Mike Fuchs** is in Cambridge working in personnel management. **Bob Wilk** and wife are in Pittsburgh where Bob is working for a bank. Bob Beckley, '71, is at Medi-Tech in Cambridge developing computer systems for hospital reporting procedures. **O. Reid Ashe** has left *Tech Review* to work for the *Charlotte Observer.* Always enjoyed talking with Reid and hope that he is happy with his new occupation. Now the classmate who made all this news possible, Edward had found the possibility of working for a large firm "unsettling" to his system and has taken a job as a research associate in the M.I.T.-Harvard Joint Center for Urban Studies. He is concentrating on various manpower studies in the construction trades, while also working as a "Principal Investigator" for a U.S. Department of Labor research project. And if that isn't enough, Ed plans to start night classes at the New England School of Law.

Participated in a beautiful wedding in Wheeling, W. Va., in June. Carl Yankowski, '71, and Sandra Griffith (Jackson '71) were wedded in a unique folk mass with **Terry Michael, Wayne Wenger** and I was best man and ushers respectively. Carl and Wayne are working at Procter and Gamble in Cincinnati as is **Sandy Harlow,** who was also present for the wedding. Sandra was attending University of West Virginia Medical School and will now be studying at the University of Cincinnati Medical School. Terry is employed by I.T.T. in their New York headquarters as a corporate planning analyst. Bonnie (his wife) and he had been vacationing in Mexico this summer. . . . See you next issue.—**Robert Vegeler,** 800 N. Smith Rd., Apt. 7W, Bloomington, Ind. 47401; **Laura Malin,** 406 Beacon St., Apt. 1, Boston, Mass. 02115

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As I write, the summer is drawing to a close and I have just finished my thesis. Who knows, I may even graduate some day. I do find that very few of the rest of you have left the campus either.

Dan (Al Tuna) **Bloom** reports that he is still unemployed and living in Burton House, but is about to change that with a job at the Institute and a move to Chestnut Hill. . . . **Jim McAtamney** expects to get an M.S. in Course XVII in February and then go in to law school, while **Charlie Mann** is also doing graduate work in XVII. . . . **Harwell Thrasher** has married Kathy Cole '73 and is working for a degree in management. . . . **Howard Haber** is working on a double degree in math and physics. . . . **Don Wade** is married to Joanne Moore and is working for an M.S. in electrical engineering. . . . **Margaret Rondio** married Robert Turek '70 and will be living in the tutor's suite of MacGregor E in the fall. . . . Mike Harvey is working as an engineer in the Planetary Astronomy Lab. . . . **Bob Dwyer** spent the summer collecting mud samples in Castine, Maine for his thesis and is now back trying to figure out what it all means. . . . **Don Levinstone** spent the summer working at Bell Labs in New Jersey on artificial speech. . . . **Steve Schladover** spent some time this summer touring Scotland. Together with **Robert A. Walter** and **Pete Welling** they will be back at the Institute this fall. Pete has his hands full running the A.P.O. Orientation Week effort. . . . Finally **Ernie Brogmus** is still hanging around the Walker Staff.

Among those few who have not only graduated, but even left is **Larry Klein,** who is studying in a joint M.D.-Ph.D. program at Johns Hopkins in psychology. He spent the summer working at a camp. . . . **Larry Marden** is at the University of Chicago studying math. . . . **Stan Zeitz** and **Faruq Ahmad** are at Stanford as is our class president, **Sandy Weiner.** . . . In law school are **Debby Bovarnick** at B.U. and **John Krzywicki** at Harvard. . . . **David Gluss** and **Mark Fuller** are at Penn studying electrical engineering and **Duncan Allen** is working for a master's in transportation at the University of Toronto.

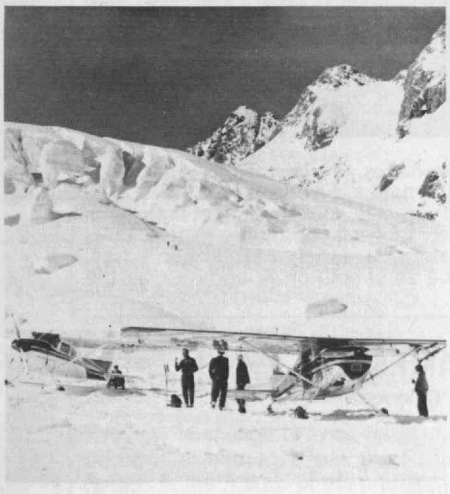
If you have any suggestions about the Institute we now have one of our own, **Becky Donnellan** on the Corporation. See where Orientation week will get you! . . . **George Flint** has spent the summer helping to run the Urban Vehicle Design Competition. . . . **Joe Auer** went into the army in July while **Warren Lippit** is in the Navy in Washington, reportedly staying with **Harvey Baker.** . . . **Elliot Singer** is writing a book based on his thesis about the Hare Krishna people. . . . **Don Coppersmith** was one of the winners of the national Putnam Mathematical Competition. . . . **Mike Feirtag** is working for *Technology Review.* . . . Finally, at least one member of our class has learned a practical skill at M.I.T. and is putting it to work. **Herb Newborn** reports that he is joining the Professional Bowlers Association.

As you all get settled into jobs, grad school, or just plain bumming around this fall I hope you will let me know what you are up to so I can relay it to the class. Don't forget to include your address and even better, include some information about what friends in the class are doing.—**Dick Fletcher,** Secretary, 135 West St., Braintree, Mass. 02184

THE SOUTH PACIFIC

29 DAYS $2100

An exceptional and comprehensive tour of AUSTRALIA and NEW ZEALAND, with optional post-tour visits to south seas islands such as FIJI and TAHITI. Starting on the North Island of New Zealand, you will visit the country's major city of AUCKLAND, the breathtaking "Glowworm Grotto" at WAITOMO, and the Maori villages, boiling geysers and trout pools of ROTORUA, then fly to New Zealand's South Island to explore the startling beauty of the snow-capped SOUTHERN ALPS, including a flight in a specially-equipped ski plane to land on the Tasman Glacier, followed by the mountains and lakes of QUEENSTOWN with a visit to a sheep station and a thrilling jet-boat ride through the canyons of the Shotover River. Next, the haunting beauty of the fiords at MILFORD SOUND and TE ANAU, followed by the English charm of CHRISTCHURCH, garden city of the southern hemisphere. Then it's on to Australia, the exciting and vibrant continent where the spirit of the "old west" combines with skyscrapers of the 20th century. You'll see the lovely capital of CANBERRA, seek out the Victorian elegance of MELBOURNE, then fly over the vast desert into the interior and the real OUTBACK country to ALICE SPRINGS, where the ranches are so widely separated that school classes are conducted by radio, then explore the undersea wonders of the GREAT BARRIER REEF at CAIRNS, followed by a visit to SYDNEY, magnificently set on one of the world's most beautiful harbors, to feel the dynamic forces which are pushing Australia ahead. Limited visits to South Pacific islands such as Fiji and Tahiti can also be included at no additional air fare. Total cost is $2100 from California. Departures in January, February, April, June, July, September, October and November 1973.



EAST AFRICA

22 DAYS $1739

A luxury "safari" to the great national parks and game reserves of East Africa, offering a breathtaking combination of wildlife and scenery: game viewing in the wilderness of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL PARK; the spectacular masses of pink flamingos at LAKE NAKURU; multitudes of lion, zebra, wildebeest and other plains game in the MASAI-MARA RESERVE and the famed SERENGETI PLAINS; the great permanent concentrations of wildlife in the NGORONGORO CRATER; tree-climbing lions along the shores of LAKE MANYARA in the Rift Valley; photographing rhino and other big game against the majestic snow-covered background of Mt. Kilimanjaro in the AMBOSELI RESERVE; and the vast and fascinating wilderness of TSAVO NATIONAL PARK, renowned for its elephant and lion and for the unusual desert phenomenon of the Mzima Springs. There is also a stay in NAIROBI, the most fascinating city in East Africa, as well as features such as a visit to a MASAI MANYATTA to see tribal dancing and the tribal way of life. The altitude in East Africa provides an unusually stimulating climate, with bright days and crisp evenings (frequently around a log fire), and the tour follows a realistic pace which ensures a full appreciation of the attractions visited. Total cost is $1739 from New York. Optional extensions are available to the VICTORIA FALLS, on the mighty Zambezi River between Zambia and Rhodesia, to UGANDA, and to the historic attractions of ETHIOPIA. Departures in January, February, March, May, June, July, August, September, October, November and December 1973 ($26 additional for departures in June, July and August).

NORTH AFRICAN ADVENTURE

Preliminary Announcement

A new tour to North Africa and the regions which surround it, visiting GIBRALTAR, MOROCCO and the CANARY ISLANDS. GIBRALTAR, the gateway to North Africa, is the first stop, followed by a crossing of the narrow Strait of Gibraltar to TANGIER, on Morocco's northern coast. From Tangier, the tour proceeds by road to the imperial cities of MEKNES and FES, with an excursion to the Roman ruins of VOLUBILIS, then crosses the Atlas Mountains to the pre-Sahara and ERFOUD, on the edge of the desert. From here, the famed "casbah trail" leads through TINERHIR and OUARZAZATE to MARRAKECH, where an extended stay is provided before continuing to CASABLANCA. The visit to the CANARY ISLANDS, lying off the coast of Africa, will include stops in TENERIFE, the volcanic island of LANZEROTE, and LAS PALMAS. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

MEDITERRANEAN ODYSSEY

Preliminary Announcement

An unusual blend of countries in the Mediterranean area, visiting TUNISIA, the Dalmatian Coast of YUGOSLAVIA, and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches at ZARZIS and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful Dalmatian Coast of Yugoslavia is represented by SPLIT, with its famous Palace of Diocletian, and the medieval walled city of DUBROVNIK, followed by the island of MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic seige of the Turks and helped to decide the fate of Europe. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

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Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes. Individual brochures on each tour are available, setting forth the detailed itinerary, hotels used, and other relevant information.

* * *

For Full Details Contact:

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One North Broadway
White Plains, N.Y. 10601

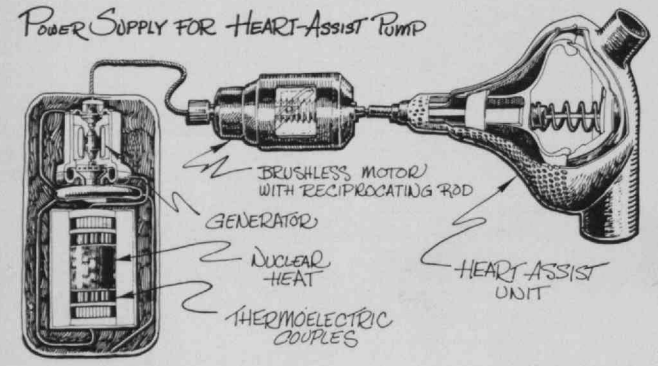
Conversation Pieces

Technically intriguing items from TRW, guaranteed to add luster to your conversation, and amaze your friends.

The Interplanetary Heart What have satellites to do with the human heart? Quite a bit, it turns out. Outer space and the human body are alike in that objects which man places in either must operate unattended in a demanding environment for long periods of time.

Consider, for example, TRW's Pioneer-Jupiter satellite. Even though it travels fast enough to get to the moon in eleven hours, it takes Pioneer around two years to get to Jupiter, the first of the outer planets. During its long flight away from the sun, the satellite's electrical power is supplied by a device which uses the heat from a nuclear isotope to generate electricity (a radioisotope thermoelectric generator). In addition, some of Pioneer's delicate instruments are protected from low temperature damage by nuclear-fueled heaters.

POWER SUPPLY FOR HEART-ASSIST PUMP



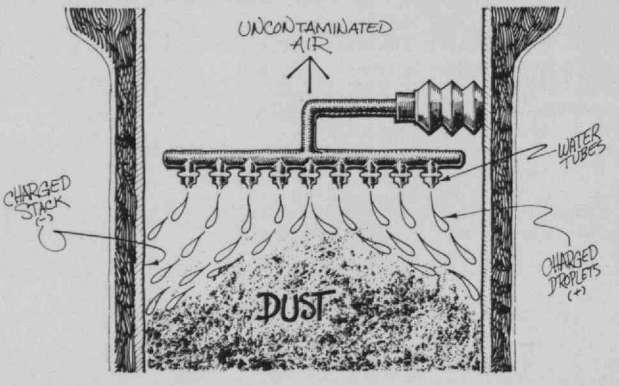
The technology associated with such long-lived, reliable heat sources is now being applied to the human heart. TRW scientists are working on suitable nuclear energy sources for heart-assist pumps, developing radioisotope heat capsules and studying thermal converters.

Placed within the body, the capsule releases heat energy through low radiation level radioactive decay, and the converter turns the energy into power for the heart pump. (The motor for the pump, incidentally, is based on those used in the Minuteman guidance and control gyrocompass, which have been operating at 16,000 rpm for more than four years.)

The severe reliability levels called for by flight to an outer planet make you refine and sharpen your technology to extremes, whereupon it suddenly becomes useful here at home within the body of a living man.

Controlling Your Attitude & Air Pollution Keeping a satellite pointed in the right direction can call for a reliable, highly efficient propulsion system. At TRW we've developed one. Called the colloid thruster, it works by electrically charging a mist of colloid-sized droplets, accelerating them through a high potential, and ejecting them out into space.

ECOLOGICAL ASSIST FROM A COLLOID ENGINE



Recently, we put this principle into an industrial smoke stack. It removed 99% of the particulate matter (such as fly-ash) billowing forth into the atmosphere. A series of needles emitting positively charged droplets were accelerated toward the negatively charged walls of the stack. On the way, they entrained almost all of the dust particles. Result: a smokeless stack.

Now we are at work with an asphalt association in removing particles from the smoke of asphalt plants. They say it's much better than the expensive solutions they have tried in the past.

We're very happy about that. When people at cocktail parties complain to us about modern technology, we have still another rejoinder.

For further information, write on your company letterhead to:

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